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ABSTRACT

This paper clarifies the role of medical education in the large health care system, estimates the resources required to carry on medical education programs and the benefits that accrue from medical education, and answers a few fundamental policy questions. Cost estimates are developed on a program-by-program basis, using empirical economic analysis as well as the results of previous studies. Benefits are also discussed on a program-by-program basis, with quantitative estimates where appropriate and feasible. The analysis raises some serious questions about the advisability of continued expansion of medical education in the U.S. Suggestions for future research are discussed. Appendices are included. (Author)

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PLANNING AND DECISION MAKING FOR MEDICAL EDUCATION: AN ANALYSIS OF COSTS AND BENEFITS

Paul Wing

Paper P-28

January, 1972

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PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

This paper, which is the author's doctoral dissertation for the Industrial Engineering and Operations Research Department at the University of California at Berkeley, is an attempt to clarify the role of medical education in the larger health care system, to estimate the resources required to carry on medical education programs, to estimate the benefits that accrue from medical education, and to answer a few fundamental policy questions. Cost estimates are developed on a program by program basis, using empirical economic analysis as well as the results of previous studies. Benefits are also discussed on a program by program basis, with quantitative estimates where appropriate and feasible. The analysis raises some serious questions about the advisability of continued expansion of medical education in the U.S. Suggestions for future research are discussed.

By couching the discussion primarily in terms of the factual bases for decisions regarding medical education, the paper provides a rather different perspective on the subject than is usually seen. This reveals inadequacies in many studies of both costs and benefits of medical education, but it also suggests in a constructive sense both improvements that can be made in these analyses and priorities for future work.

Subscribers to this series will note that Chapter 4 of this paper appeared earlier with only minor differences as Paper P-19. Chapter 4 is such an integral part of this paper that it was decided to leave it as is, despite the duplication involved.

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CHAPTER I

INTRODUCTION AND PERSPECTIVE

In the past, public sentiment and financial support has been so favorable to medical and other higher education that, for all practical purposes, systematic planning has not been required. However, as educational costs rise, and competition for funds increases, there will be a need for more coherent plans based on factual evidence and good solid analysis. This paper suggests a more systematic and comprehensive approach to medical education planning which we hope will be useful to medical education administrators and decision makers.

Our analysis has two major segments: the first is an investigation of the nature of the problems facing medical education planners and some of the approaches to these problems that seem particularly appropriate; and the second is an analysis of costs and benefits of medical education with a discussion of various national, state, and local decisions. Procedures, organizational structures, and data specific to the University of California are occasionally referred to in the text where they seem to illuminate an issue or problem, but the report is intended primarily as a general discussion of the issues and problems facing analysts of medical education rather than a planning document for a particular medical school or university.

Although much of our analysis is relevant to planning and decision making for both public and private medical education, we have restricted our set of policy questions to those related primarily to public medical education programs and expenditures. This is not a reflection of the value or quality of private medical education, but merely our feeling that public institutions have a greater obligation than do private ones to select alternatives that are efficient and serve a broad cross section of the public.

OBJECTIVES OF MEDICAL EDUCATION

The formulation of objectives in medical education, and in education in general, is a difficult problem. Bebell has pointed out three major problems: Most goal statements represent generalizations, the implications of which are usually not clear. Goal language is often emotionally loaded. And goals often tend to threaten people; they may agree in principle but not in practice because of differences in priorities.[1] Unfortunately, there seems to be no way to avoid these problems. Thus it will remain the task of "disinterested" analysts to examine stated objectives in light of the facts and draw conclusions about the actual objectives.

[1] Bebell, C. F. S., "The Educational Program," in Morphet and Jesser, eds., Emerging Designs for Education, Tallahassee: Educational Systems Development Center, Florida State University, 1968.

Charles Perrow argues that "the type of goals most relevant to understanding organizational behavior are not the official goals, but those that are embedded in major operating policies and the daily decisions of personnel."[2] An analysis of the "embedded" goals of medical education is beyond the scope of this study; we mention it primarily to emphasize that actual objectives (as implied by actions) may differ substantially from stated objectives.

An interesting preliminary analysis of objectives of public medical education has been done by Ronald Loshin.[3] He has considered the problem from two perspectives, the first assuming that the university and university education is an end in itself, and the second assuming that education is a means to some further end. He was unable to select a single ultimate objective out of the set that he considered, but he did consider the implication for both society and the university of selecting each of the alternatives. He concluded that the choice of objectives would probably have significant impact on both the resources allocated to the institution and the relation of the institution to society.

[2]Perrow, C., "The Analysis of Goals in Complex Organizations," American Sociological Review, Vol. 26, No. 6, December 1961, pp. 854-661.

[3]Loshin, R. S., "Public University Objectives for Medical Education," (mimeo), DRAFT, Berkeley: Office of Health Planning, University of California, 1969.

Mark Blumberg, drawing in part on Loshin's analysis, abandoned the search for a single objective, and considered instead multiple objectives.[4] This poses problems for decision makers, but seems to be the only way to adequately reflect the diverse interests of the various constituencies served by medical schools. His discussion of assumptions and implications of alternative objectives makes it clear that agreement on even a set of objectives will not come easily. Many are in conflict for different constituents, and measurement problems are common.

In this paper we assume, as did Blumberg, that better health is the primary objective. Health care and medical education are means to this end. We will consider several of the secondary objectives (e.g., income and opportunity redistribution) when they are relevant to the discussion.

THE CURRENT STRUCTURE OF MEDICAL EDUCATION

In the U.S. the formal training of physicians[5] is accomplished

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[4]Blumberg, M. S., "Alternative Goals of State Universities in Higher Education in the Medical and Health Fields," (mimeo), DRAFT, Berkeley, California, May 5, 1970.

[5]The terms "doctor", "physician", and "M.D." are often used interchangeably. In this paper we use the terms "doctor" and "physician" to mean practicing physicians. The term "M.D." refers to medical school graduates regardless of whether they are licensed to practice medicine. "House officer" refers to interns and residents. "Clinical fellow" refers to an advanced resident supported by one of several types of fellowships; while most schools keep separate records for them, the distinction between them has been disappearing in recent years.

in three consecutive stages subsequent to a premedical education that usually involves a baccalaureate degree: a four year medical school program, a one year internship, and a residency program of from one to six or more years. Figure 1-1 outlines this structure schematically. The medical school program includes most of the didactic training as well as introductory clinical training. The internship is intensive on-the-job exposure to clinical practice, usually in a hospital setting, and the residency provides an opportunity for the physician to learn, again in a hospital setting, and become qualified to practice in one or more of the medical specialties that have evolved over the years.

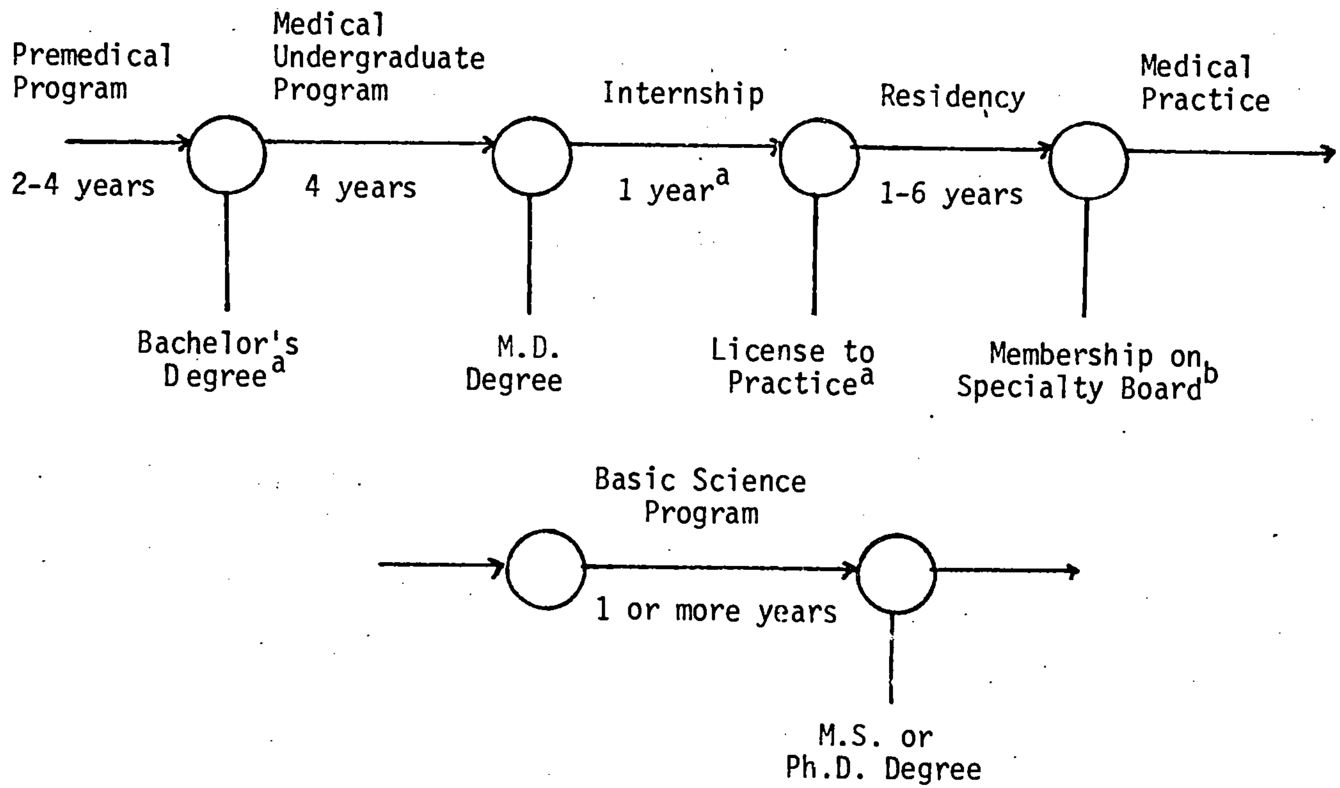
Since the internship is a prerequisite to obtaining a license to practice medicine in almost all states, nearly all new M.D.'s take an internship. Similarly, participation in a residency program approved by a medical specialty board (a professional group that sets training standards for a specialty) is required of prospective members of the specialty board. The residency situation is confused somewhat by the fact that a physician need not be a member of a particular specialty board in order to declare himself a specialist. But since the trend is more to specialization and longer residencies, the percentage of self-declared specialists is declining.

Medical schools do not control all internship and residency programs, although the fraction they control is growing. In

FIGURE 1-1

SCHEMATIC REPRESENTATION OF THE

MEDICAL EDUCATION SEQUENCE



[a]Typical but not universal.

[b]Specialty Board membership not required for specialty practice.

1967-68 some 45 percent of internship programs and 37 percent of residency programs were run at hospitals which were not affiliated with a medical school.[6] Nor do medical schools train only physicians. They also have substantial enrollments at the masters, doctoral, and post-doctoral levels in programs in the so-called basic sciences. We have found it useful to think of these programs as the laboratory science counterparts of the clinically oriented residency programs. The students in these programs, usually referred to as "Basic Science Students" or "Graduate Academics", typically flow in a stream parallel to that of medical education (see Figure 1-1), although it is not uncommon to see M.D.'s enrolled in these programs for additional background.

Although M.D. graduates are generally recognized as the primary output of medical schools, there are many indications that this premier position is more imaginary (or political) than real, particularly at established schools. The professional advancement of faculty is achieved through research and publications and the development of new clinical procedures and not through teaching medical undergraduates. Thus, the actual preference of basic science faculties for basic science students and clinical faculties for residents and clinical fellows is quite natural. Even the organization of medical schools tends to foster

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[6]Table 5, p. 2027, and Table 11, p. 2033, "Medical Education in the U.S.," JAMA, CCVI, No. 9, November 25, 1968.

TABLE 1-1

Student Enrollments, Faculty Counts, and Aggregate Expenditures
At U.S. Medical Schools in Recent Years

Year	No. of Schools[b]	No. of M.D. Grads	No. of M.D. Students	No. of Interns, Residents[c]	No. of MS or Ph.D. Candidates	No. of Post Doc. Students	No. of Fulltime Faculty	Expenditures[a]	
								Sponsored Programs	Regular Programs
50-51	72-7	6,135	26,186	6,045	4,281	1,238	3,993	NA	NA
55-56	76-6	6,845	28,748	8,286	2,387	2,000[d]	6,719	NA	NA
60-61	81-4	6,994	30,093	17,000	3,304	4,317	11,111	$250.5	$195.5
65-66	84-3	7,574	32,835	10,950	7,056	5,014	17,149	$573.0	$309.2
70-71[d]	90-5	9,064[e]	38,409[f]	22,980	8,500	8,500	20,500	NA	NA
75-76	98-4	11,400[e]	48,548[f]	24,430	12,500	12,500	24,250	NA	NA

[a] Overhead on contracts and grants has been added to Sponsored Programs and subtracted from Regular Programs as presented in JAMA Education issues.

[b] Four year schools - two year schools

[c] This does not include all interns and residents but only those in programs affiliated with medical schools.

[d] Estimated

[e] Table 17, page 72, of Blumberg, M. S., " Recent Trends and Projections of Physicians in the U.S., 1967-2002," (mimeo), Berkeley: University of California, March 31, 1970.

[f] Based on the "medium 15" series of medical school entrants in Table 8, page 42, and estimated attrition rates presented in Appendix A of Blumberg, op. cit.

Source: "Teaching Responsibility of Medical School Faculty," Datagram, Journal of Medical Education, Vol. 42, No. 7, Part 1, July 1967, pp. 718-9.

these relationships. In most medical schools, the departments are the centers of power and the faculties of these departments can hardly be expected to favor undergraduates to advanced students who have selected their own departmental specialties. Programs which cross departmental boundaries, particularly the medical undergraduate program, offer less opportunity for professional advancement to a faculty member. Why should a faculty member from a particular department want to teach medical students when he knows that the student is spending most of his time with faculty from other departments?

In constrast with established schools are new and proposed schools. They are typically justified as a means to educate additional M.D.'s. The other programs are included to fill in the workloads for individual faculty members, particularly those with unusual specialties. However, as the schools and departments mature, the shift in emphasis noted above occurs. The end result is that the medical undergraduate program becomes a secondary (though necessary) program of medical schools while graduate programs (residency and basic science) become the primary educational programs.

RECENT TRENDS IN MEDICAL EDUCATION

From World War II to the late 1960's medical education, with much of the financial support coming from the Federal government, became heavily involved in scientific research in both the clinical and

and basic medical sciences. The resulting shift in program emphasis was substantial as is obvious from Table 1-1. While the number of M.D. graduates has increased by roughly 50 percent since 1950, full-time faculty has quintupled and other student categories have more than tripled. Thus it is clear that medical education has grown substantially in this period, despite the relatively small increase in the output of M.D.'s.

ROLE OF MEDICAL EDUCATION IN THE LARGER HEALTH SYSTEMS

Since we will be evaluating medical education primarily in terms of its impact on health, it is appropriate to indicate the relationship of medical education to the larger health system. Figure 1-2 presents a schematic representation of this relationship adapted from a framework for health manpower research developed by Irene Butter.[7] The essential thing to note is that a great deal more than medical education is required in order to obtain a health system. Facilities, other health professionals, education programs, etc. are all needed to round out the system.

THE ROLE OF INDIVIDUAL MEDICAL SCHOOLS IN MEDICAL EDUCATION

Although no single medical school can be said to represent U.S. medical schools, it is interesting to look at the role of a particular

[7] Butter, I., "Health Manpower Research: A Survey," Inquiry, 1967.

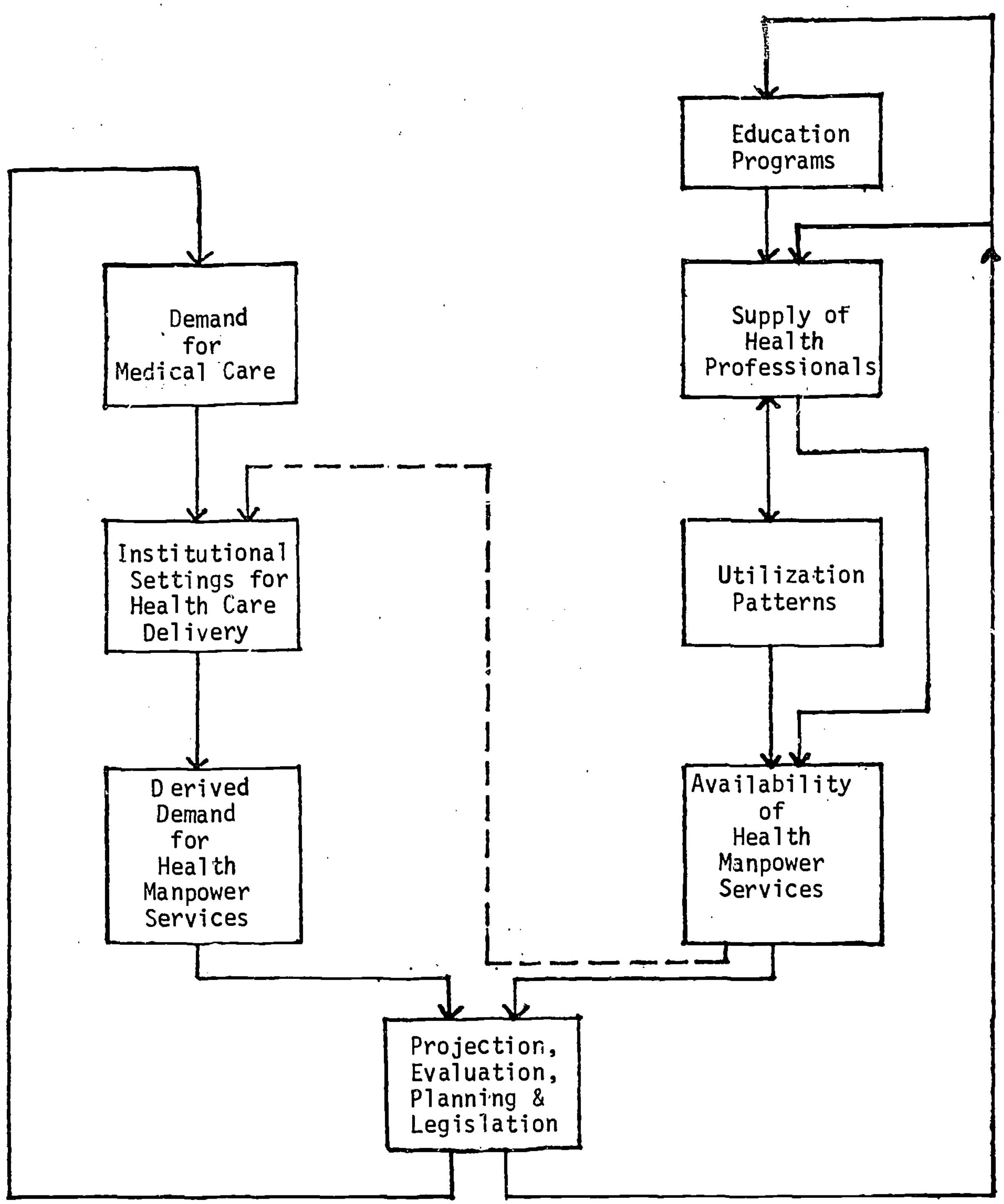

FIGURE 1-2: Schematic Representation of the Relation of Medical Education to the Larger Health System

school in the larger medical education system since it does exemplify many of the situations, problems and questions that arise at individual schools. Medical education consumed $95.3 million at the University of California in 1967/1968 which represented 11.6 percent of the total university expenditures.[8] One major result of these expenditures was the graduation of 290 new M.D.'s from the medical undergraduate programs. Other important outputs were the 318 interns, 1143 residents, 216 basic science students, and 379 postdoctoral students who completed the year at one of the three active University of California medical schools.[9] The public service and research conducted on the campuses, though not easily itemized, were also major outputs of the schools.

Although the outputs from the three University of California schools (UCLA, UCSF, UCI) are substantial, the University of California programs are only a small part of the total medical educaiton system in the United States. Even more important is the fact that their production, however large or small, is not coordinated in any significant way with that of other schools. Just as the departments are the centers of power at the schools, the schools are the center of power at the national level. This is neither good nor bad *per se*, but given

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[8]This includes hospital expenses and sponsored research as tabulated in "Financial Schedules, Fiscal Year 1967-68," Berkeley: University of California.

[9]Table 1, p. 1994, and Table 4, p. 2086, "Medical Education in the U.S. 1967-68," *JAMA*, 206, 9, November 25, 1968.

the general lack of information about health manpower and its production it is probably very wasteful to have so little central coordination.[10]

Unfortunately, the scarcity of facts about the determinants of health and the provision of health care seems to indicate that it will be some time before a coherent national policy on medical education evolves. Since a uniform factual basis is a prerequisite to coordinated planning and decision making, it would appear that the University of California and other schools will have to continue in their roles as relatively independent producers of physicians.

ORGANIZATION OF THIS PAPER

This paper is concerned primarily with the problem of allocating resources to and among programs at public medical schools. In contrast with many of the recent studies in higher education planning which have been rather theoretical, we have chosen a more pragmatic, policy oriented study which we feel can have a more immediate impact on the direction of medical education. Since prospects of financial difficulties at all levels of both medical schools and government have left planners and administrators more

[10] For example, the long time lag between decisions to expand medical school enrollments and the increases in physician output is so long (about ten years) that there is a possibility that under current arrangements too many or too few physicians may be produced. This may not be disastrous, but it may be a very inefficient use of resources.

open to discussion about changes in priorities. Perhaps we have a chance to have a significant impact.

An important premise that underlies this entire analysis is that emphasis in medical education can change only slowly. When discussing decisions related to program mix, particularly changes in program mix, it is probably not useful to consider alternatives which would significantly change the structure or operation of a school over a short period of time. This is because of a combination of natural reaction to change and the substantial dispersion of power at medical schools which would make significant short run changes very difficult to achieve. This premise, in conjunction with our desire to influence more immediate decisions and the general lack of data on costs of and benefits from medical education programs, has led to the choice of analyses presented here.

Chapter 2 discusses briefly the two most important approaches to medical education decision making. Chapter 3 discusses several prior studies of medical education as well as studies of health and education that are of potential value in medical education planning and decision making. Chapter 4 presents an original analysis of the costs of medical education. Chapter 5 discusses the benefits of medical education. Chapter 6 pulls together the findings of Chapters 4 and 5 to answer several important policy questions regarding medical education. And finally, Chapter 7 summarizes the results, presents a few conclusions, and speculates about appropriate directions for medical education in the near future.

CHAPTER 2

DECISION MAKING IN MEDICAL EDUCATION

Decision making in medical education, as in any other complex system or organization, is a group process. And one should not need to be told that the "group" that "makes the decisions" in medical education is anything but coordinated and organized. Given this fact of life, it seems quite important to discuss the sorts of decision-making environments that the medical education planner is likely to encounter. This may be very relevant to his choice of analyses, report content and mode of presentation. A complete discussion of the subject is beyond the scope of this project, but we can indicate roughly how the "system" operates and where the decisions are made.

DECISION MAKING VS. PLANNING

Although not directly relevant to the main thrust of this paper, we believe that there is a need for a brief discussion of the distinction between planning and decision making. "So long as 'planning' can mean almost anything, planners can both use the approbation the concept brings and avoid the limitations imposed by any single designation of function."[1] And so long as planning and decision making remain undefined, one cannot adequately evaluate either of them.

[1] William Petersen, "On Some Meanings of Planning," Journal of The American Institute of Planners, May 1966, p. 130.

By "planning" we mean: the rational process of mapping out the consequences of specific actions in relation to a desired set of objectives. Implicit in this definition is a coherent set of objectives. By "decision making" we mean: the rational process of selecting one of two or more plans or courses of action.[2] Although for an individual person decision making implies planning (i.e., in order for an individual to make a decision, he must have reasoned out the consequences of the alternatives, however imperfectly), we do not believe this to be the case for an organization, except in the situation where responsibility for both planning and decision making is formally or informally vested in the same group or individual.[3]

The question that arises at this point is whether an organization should have a joint planning-decision making group or individual. Although it may be more efficient to have such an arrangement, particularly in small organizations, we believe that for organizations with public responsibilities (such as public medical schools), planning and decision making should be separate functions performed by separate groups or individuals. The threat that a joint planner-

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[2]Since we are only trying to establish a coherent basis for the sequel here, we will not discuss such things as rationality. Let us just say that in this discussion rationality implies stability over time.

[3]This dichotomy between planning and decision making is discussed is some detail by C. A. Anderson, "Theoretical Considerations in Educational Planning," in G. Z. F. Bereday and J. S. Lauwerys, eds., <u>Educational Planning, World Year Book of Education, 1967</u>, New York: Harcourt, Brace & World, 1967.

decision maker may be corrupted or be misguided is too real to allow such a joint arrangement. At least if planning and decision making are separate functions and the plans are made available to the public, there is some semblance of a check on the performance of the decision maker.

DECISION MAKING MODELS

There are two basic decision making models in medical education: political and economic. Although there are some overlaps, the political models are relevant primarily to institutional decisions, and the economic models are relevant primarily to individual decisions. We will briefly discuss each of these in turn.

Political Systems

Decision making based on political power and persuasiveness has a long history in western culture. While it may not always be efficient and it tends to favor those in positions of wealth and power, it has been a remarkably effective system for allocating resources in areas where no real agreement exists about values or objectives. And it seems clear that some sort of formal political framework must remain to reconcile and resolve conflicts (via vote trading and buying) based on differences in preferences and priority structures. This seems to be the principal "decision system" that medical education planners will be facing for some time to come.

It might be reasonable to discuss two classes of political decision making, one based on formal political organizations and the other on informal arrangements and interactions, but we prefer to consider only one class based on the resolution of conflicts and differences of opinion through power and influence. The process may have a loose, fluctuating formal structure such as a state legislature; or it may be very informal like the "process" described by Elizabeth Drew in the Atlantic Monthly several years ago.[4] In formal systems priorities shift relatively slowly, principally when new appointments are made, and the principal decisions are often the appointments themselves. Legislative systems are likely to be more erratic; devotion of individuals to particular causes and the resulting vote trading may result in policy shifts from session to session, although a general stability usually prevails. Informal systems are based primarily on proximity to influential people; the final actions generally come from one of the formal systems, but the stimulus comes from informal contacts.

Political Decision Making Centers

While it is not possible to draw up a comprehensive list of decision making centers in medical education, it is of some interest to list some of the major classes of decisions and decision makers. This provides additional perspective on the complexity of the problems

[4]Drew, E.B., "The Health Syndicate," Atlantic Monthly, December, 1967.

facing planners and analysts. Table 2-1 presents such a list. Although it is very abstract, we think it does identify the centers of influence in the major classes of medical education decisions. Figure 2-1 provides an additional perspective by clarifying the basic interaction patterns of the major decision makers in medical education. Additional detail can be found in the discussion of decision making in medical education by Fein and Weber.[5]

Even more important to this discussion is the role of special interest groups, particularly the AMA. Although it is only indirectly concerned with medical education, the AMA is the most influential of the power groups in medical education today. The licensing and certification powers that are held by its member doctors at both national, local and institutional levels provide the AMA with significant influence over both expansion and innovation in medical education. It is not our objective here to delve into the details of the the influence patterns, since this has been done elsewhere.[6] We merely want to indicate that physicians have significant control over the future of their profession and planners should not fail to consider this when preparing their reports.

Federal agencies, despite their increasing role in the financing of medical education, seem to be staying away from major decision making.

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[5]Fein, R. and G. I. Weber, Financing of Medical Education, New York: McGraw-Hill, esp. pp. 33-8.

[6]Elton Rayack in his book, Professional Power and American Medicine: The Economics of the American Medical Association (Cleveland: World Publishing Co., 1967), has discussed the role of the AMA in medicine in considerable detail.

TABLE 2-1

CLASSES OF DECISIONS AND PRINCIPAL DECISION MAKERS AT PUBLIC MEDICAL SCHOOLS

CURRICULUM - NEW PROGRAMS

Department Chairmen, Faculty, Deans
University Officers
Accreditation and Licensure Groups
Affiliated Hospitals

BUDGET

State Government
Campus and University Officers
Deans, Chairmen

CONSTRUCTION

University Officers, Campus Officials
State Government
Federal Government Grant Agencies
Private Agencies and Donors

RESEARCH

Federal Agencies, NIH, PHS
Faculty
Private Foundations

STAFFING

Department Chairmen
Deans, Faculty

ENROLLMENT - ADMISSIONS

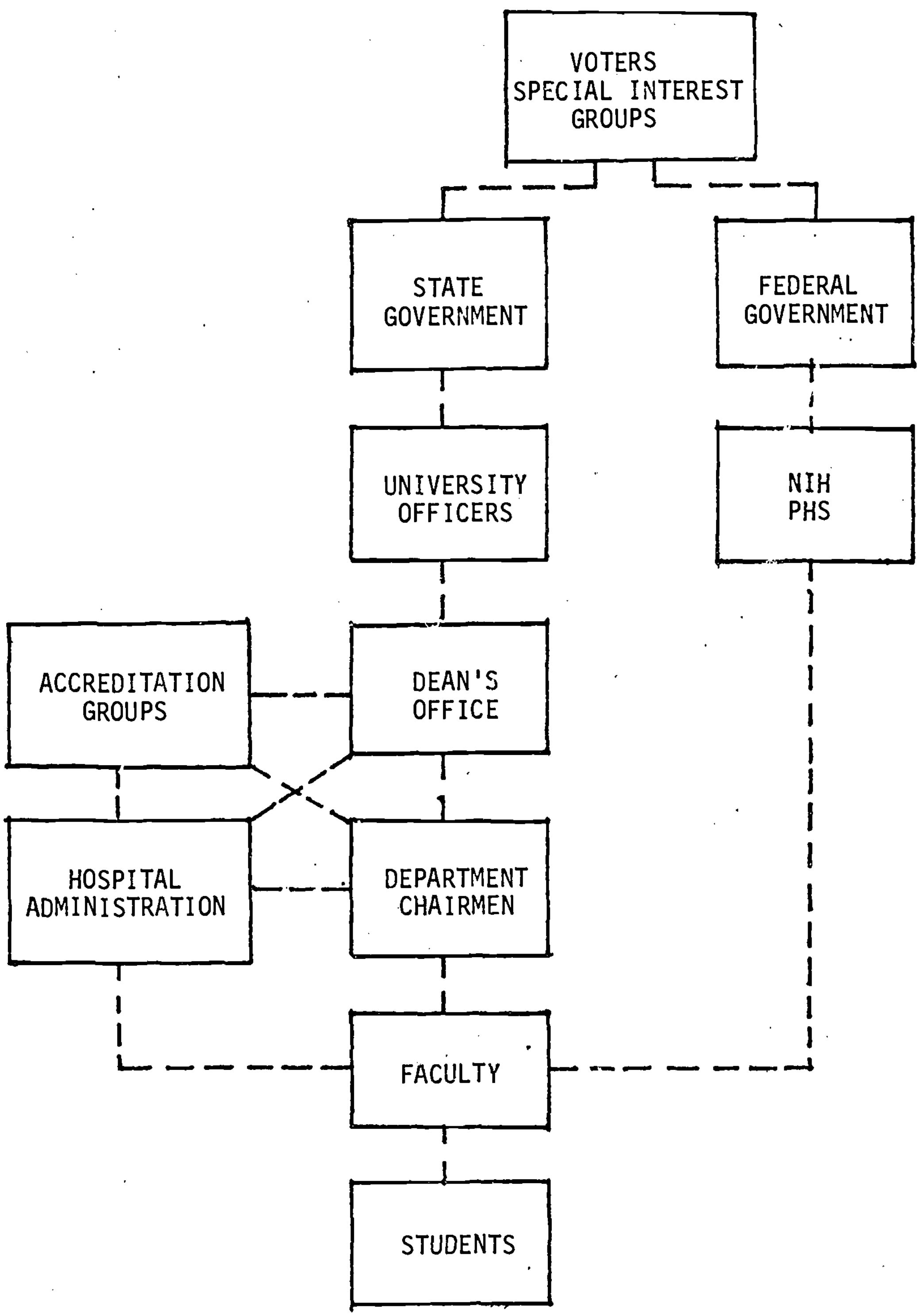
Department Chairmen, Deans, Faculty
Students

PATIENT CARE

Patients - Private and Departmental
Hospital Staff and Physicians
Health Insurance Companies
City and County Governments

FIGURE 2-1

GENERAL PATTERNS OF INFLUENCE IN MEDICAL EDUCATION DECISION MAKING



They affect the shape of programs but the little evidence that is available seems to indicate that they act more as catalysts than initiators of change. That they have an impact has been shown very dramatically by Mark Blumberg. He noted a dramatic positive correlation between federal funds (received under the Health Professions Education Assistance Act, as amended June, 1969) and both absolute and relative growth of entering classes at medical schools.[7]

Other than these two "outside" groups, most of the substantive decisions are made at the departmental level at the individual medical schools. Needless to say, this makes more difficult the implementation of any major innovations and changes in medical school programs and curricula.

Economic Systems

Economic systems have been the basis for most of the private business transactions in the U. S. but there has been little effort to develop actual or pseudo markets for regulating transactions in social fields. This is particularly true in fields like health, education, and welfare in which there is little incentive for private enterprise to join the action. In such fields political systems have evolved instead. While it is clear that formal economic

[7] Blumberg, M. S., " Medicine and Related Occupations", (mimeo), Berkeley: Office of Health Planning, University of California, December 1969, pp. 82-6.

markets eliminate sources of political power and influence, they are generally rather efficient mechanisms for guiding resource allocation decisions.

Although we do not see any significant opportunities to institutionalize economic decision making systems in medical education[8], it is of some interest to consider the collective actions of individual physicians as economic market phenomena. Such an approach can be used as the basis for study of the impact of plans and proposals for medical education, particularly at the national or state level. Such things as the effect of a new medical school in state A on physician supply in state A could be analyzed on this basis.

A discussion of responses to changes in supply and demand for professional services by Mark Blumberg provides an interesting supplement to our previous discussion of political decision making systems. He suggests that reactions of physicians (and other health professional groups) to changes in supply and demand for their services can usually be explained in terms of a natural economic self

[8]The National Intern and Resident Matching Program (NIRMP) is a rare example of a formal market system in a social context. It serves primarily as an information exchange mechanism, but we think it properly qualifies as a market system. More sophisticated market systems would probably not be well received. Consider, for example, the likely reaction to a state or national market for selling licenses to practice medicine. One purpose of such a market might be to establish an "equitable" geographic distribution of physicians across a state or the nation. By establishing high license costs in areas with relatively many physicians and low (even negative) license costs in areas with relatively few physicians, it might be possible to divert physicians to areas of low supply.

interest.[9] This does not simplify the decision making process, but it does suggest that economic analysis might be an appropriate way to study the impact of proposals for new medical education programs, etc. on physicians (and other power groups).

Since we are concerned here primarily with institutional decisions we will not pursue this subject further at this point. Frankly, we see little potential for improvement or change through such a discussion. Political processes seem firmly entrenched as the primary decision making mode, and while these are undoubtedly fascinating subjects for study, there seems to be little hope for altering them from the outside. We proceed here on the premise that more can be accomplished by providing more facts and figures to the decision makers.

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[9] Blumberg, M. S., "Response of the Health Professions to Changes in Supply and Demand for their Services," (mimeo), Berkeley, California: June 1970, 16 pp.

CHAPTER 3

ALTERNATIVE APPROACHES TO PLANNING

Of the recent research on medical education, very little has been oriented toward administrative planning and decision making. Principal emphasis has been on health care delivery and medical technology. This is not to condemn the work that has been done, but rather to indicate that one important area of applied research has been seriously neglected.

Medical education is not unique in this regard. Kenneth Boulding has discussed the lack of an economic theory of educational "firms" in some detail[1], and his comments apply equally well to medical education. He makes it quite clear that a great deal of very fundamental analysis of educational systems needs to be done, particularly regarding what he calls the "informational variables." Informational inputs and outputs do not fit the accounting procedures set up for physical inputs and outputs, and since these are variables of principal interest in educational systems, there is certainly a need for study in this area. Until a theory of education "firms" encompassing such informational relationships in educational systems can be developed, administrators will have to do the best they can with the traditional fiscal accounts.

[1] "The University as an Economic and Social Unit," in John Minter, Colleges and Universities as Agents of Social Change, CRDHE, WICHE, 1968, pp. 75-87.

Most of the recent medical education planning studies have been qualitative rather than quantitative. While there is certainly a need for good qualitative research, it seldom provides a reliable basis for making the important decisions that face administrators at the national, state or institutional level. Problems such as defining the proper role of sponsored research at medical schools, determining the resources required to educate a new physician, or selecting the department in which to restrict growth, need quantitative as well as qualitative research.

We noted in the previous chapter that decision making for medical education is necessarily a group process. Planning, however, <u>can</u> be an individual process. It can consist of collecting and internalizing previous studies or it can involve substantial original analysis. In any case, the essence of the planning process is the enumeration and evaluation of the results expected of one or several specific courses of action. Two major approaches to this process that have been formalized over the past several decades are systems analysis and cost-benefit or cost-effectiveness analysis. Each has merits and shortcomings, and in light of the nature of the decision making processes that we must rely on, it seems appropriate to introduce both of them. They may lead to more efficient utilization of resources, better understanding of problems, and/or clearer notions about objectives, but they are only tools for decision makers, not ends in themselves. But since they deal primarily with quantifiable variables and parameters and cannot cope with subjective and qualitative variables, it is possible that they represent a threat to society in a very real sense. Wildavsky, who has discussed this problem at some length[2], concludes that adequate decision making requires what he calls political rationality and that planning techniques such as systems analysis and PPBS should be applied carefully lest fundamental human (political) values be subordinated to economic values.

SYSTEMS ANALYSIS

Systems analysis is a generic term which refers to the systematic functional analysis of any organization or system. The analysis may have qualitative components, but it generally involves the manipulation of a mathematical representation of the system of interest. The usual objective is to determine the mode of operation or the level and mix of activities which will meet specified constraints or requirements most efficiently. Even if a complete analysis proves impossible in a particular situation, the systems approach that underlies it usually leads to improved understanding of the problem and often to improved operation of the actual system. The systems approach calls for consideration of all possible factors in the analysis; a model of the system under investigation is an intermediate objective. In developing (or attempting to develop) this model, the analyst can learn a great deal about the system, perhaps more than he learns by manipulating his model.

[2] A. Wildavsky, "The Political Economy of Efficiency: Cost-Benefit Analysis, Systems Analysis, and Program Budgeting," Public Administration Review, December 1966, pp. 292-310.

Of Medical Education

Systems analyses of medical education are not common; only two such studies have reached my attention. The most comprehensive and best known of these is one of a series of analyses of higher education from the University of Toronto.[3] They have constructed a rather detailed model of the Faculty of Medicine at the University of Toronto and discuss its use as a tool to study the implications of changes in output, production technology, or curriculum. Essentially they have established a detailed simulation model which analyzes the hours of availability of each input resource required to obtain a specified output mix given the production technology. The model "moves" students through their education programs for up to 65 times periods using a Markov transition matrix.[4]

Despite the attractiveness of this model and the general approach, it has not been widely adopted or adapted. The principal reason for this, and the principal drawback of any such system, is the

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[3]An introduction to their models can be found in Wilson, R., W. Wolfson, S. Centner and J. R. Walter, "Systems Analysis in Health Sciences Educational Planning," Canadian Medical Association Journal, Vol. 100, April 19, 1969, p. 715.

[4]Readers interested in more detail about the models are referred to Judy, R. W., "Systems Analysis and University Planning," paper presented at Symposium on Operations Analysis of Education, November 1967, Washington, D. C. A complementary model of graduate medical education is discussed in Wilson, R., I. Kilpatrick and J. R. Walter, "The Dynamics of Graduate Medical Education," Annals of the Royal College of Physicians and Surgeons of Canada, Vol. 1, No. 3, July 1969, pp. 197-211.

tremendous investment required of the potential user to estimate the coefficients in the input-output matrix. As much as $500,000 might be required over a two year period and even then the system may not prove useful.

The other systems analysis of medical education was done by the Medical Facilities Planning Group at Stanford University. They did not study the entire medical school, but focused on the clinical teaching situations and their relation to health care systems. In their report[5] they examine several analytical models, discuss their usefulness, and present a few preliminary results. The study is not a comprehensive one, even of clinical teaching systems, but it does provide the best analysis of clinical teaching at a medical school that is currently available.

Of Higher Education Systems

Whereas systems analyses of medical education are few in number, there have been many studies of other classes of educational systems, higher education systems in particular.[6] Not surprisingly, nearly all of these studies are oriented toward the solution of administrative problems. They have almost uniformly failed to deal with what may be the most important problems facing higher

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[5] "Clinical Teaching and Health Services," Part I of Clinical Teaching and Health Care Systems: Models and Evaluations, A Report to the Commonwealth Fund by Medical Facilities Planning Group, Stanford University, June 1969.

[6] A good general discussion can be found in Ryans, D. G., "Systems Analysis in Planning," in O. A. Knorr, ed., Long Range Planning in Higher Education, Boulder, Colorado: Western Interstate Commission for Higher Education, April, 1965, pp. 79-116.

education today, namely, curriculum design. As Rath has pointed out[7], the student is viewed as an object rather than a key "independent variable." Richard Durstine has recognized this shortcoming and tried to develop a model of individual learning.[8] We hope that in the future, analysts will try to adapt his models, perhaps even incorporate them into a larger scale system.

Of the more typical systems analyses of higher education, many could be adapted to the study of medical education. However, given the rather limited application such studies have had to date, we suspect that it would not be worth it to try to adapt any of these models.[9] Even the models that have been specifically oriented toward medical education have had little if any impact.

For readers interested in reviewing some of the important analytical models of university operation, we recommend the paper compiled by

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[7] Rath, G. J., "Management Science in University Operation," Management Science, Vol. 14, No. 6, February 1968, pp. B-373-395.

[8] Durstine, R. M., "Modelling the Allocation Process in Education," (preliminary draft), Cambridge: Center for Studies in Education and Development, Graduate School of Education, Harvard University, no date.

[9] Herman Koenig, whose group at Michigan State University has developed a rather elaborate decision making model (see Koenig, H. E., M. G. Keeney and R. Zemach, "A Systems Model for Management Planning and Resource Allocation in Institutions of Higher Education," East Lansing: Michigan State University, 1968), subsequently, "found it difficult to see any department chairman [or]...dean might articular his objectives in the form required [by their model]." (See Koenig, "Systems Models and their Application in Management Planning and Resource Allocation in Institutions of Higher Education," East Lansing: Michigan State University (prepared for ORSA Meeting, Miami, November 10-12, 1969, p. 19). Given this admission we wonder whether similar implementation problems may not arise in similar models.

Weathersby and Weinstein.[10] They have compared and contrasted over fifty different models, classifying them as either general university decision models, special purpose university planning models or national educational models. The special purpose models seem to offer the most promise for immediate returns, but national level models might also prove useful. We are not hopeful about the general university decision models (cf. footnote 9) although they certainly would be quite valuable if they could be implemented.

Before we move on, we would like to mention a few studies not listed by Weathersby and Weinstein which may be of some value to an interested reader, three national education planning models, and three special purpose planning models. A study by Koulourianos provides a particularly sound review of the use of input-output models for educational planning.[11] His study, and one by Irma Adelman[12], are oriented toward planning for developing countries. A pair of papers by Leonard Miller and Roy Radner are in essentially

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[10]Weathersby, G. B. and M. C. Weinstein, "A Structural Comparison of Analytical Models for University Planning," Report No. P-12, Berkeley: Ford Foundation Research Program in University Administration, University of California, 1970.

[11]Koulourianos, D. Th., "Educational Planning for Economic Growth," Technical Report No. 23, Center for Research in Management Science, Berkeley: University of California, February 1967. 266 pp.

[12]Adelman, I., "L-P Model of Educational Planning: Argentina," in Adelman & Thorbecke, eds., Theory and Design of Economic Development, Johns Hopkins Press, 1966.

the same class, although they focus more on the educational system itself rather than its impact.[13]

Capital expansion poses much the same problem for medical education as it does for the rest of higher education. Analysis of aggregate expansion might be facilitated by the use of an approach suggested by Robert Sanderson.[14] He has applied network analysis to the problem of multicampus expansion planning. At the campus level, studies like those of Graves and Thomas[15] and Dickey, Connor and Hopkins[16] might be useful in obtaining more efficient building layout and campus design.

Another study which might be a useful model for an analysis of

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[13] Miller, L. S., "A Higher Education Cost Model," (mimeo), Working Paper No. 1, Project on Econometric Studies of Higher Education, Berkeley: Carnegie Commission on the Future of Higher Education; Radner, R., and L. S. Miller, "Resource Requirements for a Universal Two Year College Program," (mimeo), Working Paper No. 2, Project on Econometric Studies of Higher Education, Berkeley: Carnegie Commission on the Future of Higher Education, February 1969.

[14] Sanderson, R. D., "The Expansion of University Facilities to Accommodate Increasing Enrollments," Ford Foundation Report No. P-3, Office of the Vice President - Planning and Analyses, University of California, Berkeley, November 1969.

[15] Graves, R. J. and W. H. Thomas, "A Classroom Location Allocation Model for Campus Planning, " (mimeo), Buffalo: Division of Scheduling and Inventory, Office of Facilities Planning, State University of New York.

[16] Dickey, J. W., Connor, G. R., and J. Hopkins, "Campus Building Arrangements Using the Branch and Bound Technique with Subjectively Established Bounds," (mimeo), Blacksburg, Virginia: Virginia Polytechnic Institute.

medical education was reported by Rosenstein.[17] This study is a very interesting analysis of engineering education and while it is essentially qualitative we think it can properly be termed a systems analysis. It focuses on a rather broad set of policy questions and makes a series of recommendations regarding the future of engineering education and curricula. While one may take issue with Rosenstein's objectives, criteria, and recommendations, his approach is certainly interesting and deserves some study as a model for academic planning for other professional education programs.

Of Health Systems

Though not directly relevant to medical education, planning analyses of health systems can have important implications for the future of medical education. In fact, without such studies the evolution of medical care and medical education is likely to be painfully uneven and slow. Navarro has discussed some of the general issues involved[18], with particular attention to critical

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[17] Rosenstein, A. B., "A Study of a Profession and Professional Education," School of Engineering and Applied Science, UCLA, December 1968.

[18] Navarro, V., "Systems Analysis in the Health Fields," Socio-Economic Planning Sciences, Vol. 3, No. 3, October 1969, pp. 179-189. Another survey can be found in Flagle, C. D., "Operations Research in the Health Sciences," Operations Research, Vol. 10, 1967, pp. 591-603.

problems of objectives and performance evaluation. A different kind of introduction can be found in a recent article by Garfield in the Scientific American[19] in which he discusses the need for a larger frame of reference in the analysis of health care delivery.

Two large scale analyses of health systems deserve some mention at this point, both executed by several overlapping groups at Stanford University and documented in a series of reports.[20] These analyses offer considerable promise as models for use in future investigation. They are for the most part theoretical in nature (that is, the models have not been fully implemented or tested), but they do seem to be reasonably complete and well structured.

The second "comprehensive" approach has been proposed by Naddor,

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[19] Garfield, S. R., "The Delivery of Medical Care," Scientific American, Vol. 222, No. 4, April 1970, pp. 15-23.

[20] Smallwood, R. D., E. H. Sondik and P. L. Offensend, "Toward an Integrated Methodology for the Analysis of Health Care Systems," Technical Report No. 6252-3, Information Systems Laboratory, Stanford University, June 1970, 36 pp; "A Model for Evaluating Medical Facility Macroplans," (mimeo), two chapters from final report of Stanford Medical Facility Planning Group to the Commonwealth Fund, Stanford: Department of Engineering-Economic Systems, Stanford University; and Clinical Teaching and Health Care Systems: Models and Evaluation, op. cit.

Shuman and Young from Johns Hopkins.[21] Their principal objective is to determine efficient locations for health care facilities in a region, but they have considered a great many important issues in their analysis. A similar but much simpler model has been suggested by Love, et. al.[22] One of its advantages is at once a disadvantage: it uses dynamic programming. At least at the current state of the art of dynamic programming, this restricts the detail that can be included in the model rather severely. However, this approach does seem to warrant further investigation.

COST-BENEFIT OR COST-EFFECTIVENESS ANALYSIS

Although seldom mentioned in the same breath, cost-benefit analysis and systems analysis are conceptually quite similar. Both are tools for studying the effects of alternative courses of action; both are applied in studies of "complete" systems; and both deal principally with quantifiable variables. The principal difference between the two ques is that cost-benefit or cost-effectiveness analysis requires knowledge of only the inputs and outputs whereas systems analysis requires specific knowledge of the internal functioning of the system. There has also been a difference in

[21]Naddor, E., L. J. Shuman and J. P. Young, "A Planning Model for Regional Health Services," paper presented at ORSA National Meeting at Miami Beach, November 1969.

[22]Love, C. G., R. A. Mathias and G. Trebbi, "Dynamic Planning of Health Care Systems," (preliminary copy), Pittsburgh: Westinghouse Electric Corporation, 1970.

the evolution of the two procedures: systems analysis, both in its theoretical foundations and applied techniques, has developed in a rather coordinated growing process, whereas cost-benefit analysis has evolved almost entirely without a theoretical basis. Several attempts have been made to develop a theory of cost-benefit analysis[23], but none of them seem to expand the concept or applicability of the technique. More useful to the practitioner is the discussion by Prest and Turvey[24], which covers in some detail the methodological issues surrounding the use of cost-benefit analysis.

The evolution of cost-benefit analysis seems much more closely related to development of understanding of institutional behavior and related data resources in specific case studies than to any theoretical foundation that may have evolved. Typically, cost-benefit and other studies (and proposals) have stimulated new data collection and refinement efforts which in turn stimulate more detailed and thorough analysis. This cyclical growth process does not seem to have led to any breakthroughs in either education or health, but there does appear to be a growth in

[23] See for example, Fox. P.D., "A Theory of Cost-Effectiveness for Military Analysis," Operations Research, Vol. 13, 1965, pp. 191-201; Heuston, M. C., and G. Ogawa, "Observations on the Theoretical Basis of Cost-Effectiveness," Operations Research, Vol. 14, March-April 1966, pp. 242-66; and Hitch, C. J. and R. N. McKean, The Economics of Defense in the Nuclear Age, London: Oxford University Press, 1960.

[24] Prest, A. R., and R. Turvey, "Cost-Benefit Analysis: A Survey," The Economic Journal, Vol. 75, No. 300, December 1965, pp. 283-735.

understanding of the issues and problems.

Of Higher Education Systems

Despite the lack of specific guidance, there are some discussions of cost-benefit analysis in higher education and some actual studies that should be reviewed by anyone interested in the subject. In the mid 1960's there was a general skepticism of cost-benefit analysis as a tool for evaluating alternatives and affecting policy. Mood and Powers noted that poorly defined goals, multiplicity of programs, lack of information, and measurement problems were major barriers to the application of the technique.[25] Jack Wiseman has also raised some serious questions. He suggested that the reason that cost-benefit studies have produced less policy accord than might have been expected, is that, for practical purposes, it is not possible to separate judgments about value of educational investment in human beings from judgments on other values which are themselves affected by education. He is "very uncertain as to how useful a policy tool benefit-cost studies alone can ever become, and suggest[s] therefore... that we should not neglect complementary approaches: studies of actual methods of provision [of education]; normative studies to study the relations between particular systems of

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[25]Mood, A. M. and Powers, R., "Cost-Benefit Analysis of Education," Technical Note No. 27, Washington, D. C.: National Center for Educational Statistics, U. S. Department of Health, Education & Welfare, March 30, 1967, 15 pp.

provision and postulated economic and social goals; broader studies of social context, etc.; and comparative studies."[26]

One of the most comprehensive cost-effectiveness models that we have come across was designed by Abt Associates as a procedure for evaluating project proposals for the Elementary and Secondary Education Act.[27] Five separate submodels evaluate the effects of different proposals on the school, the community, the instructional process, as well as overall costs and effectiveness. By running the model as part of a simulation procedure, the hope is to obtain guidance in selecting sites for the implementation of specific projects. The model was far from implementation in 1966 when the report was released and some of the required data were not available for use in pilot runs. Since we have seen no further reports, we do not know how far this study was carried.

Other analyses have discussed specific problems that arise in the definition and analysis of costs and benefits. One of these problems centers on the distributional effects of educational programs. Weisbrod was the first to examine this topic in detail, and he

[26] J. Wiseman, "Cost-Benefit Analysis in Education," Southern Economic Journal, xxxiii, No. 1, Part 2, July 1965, p. 12.

[27] "A Cost-Effectiveness Model for the Analysis of Title I ESEA Project Proposals," Parts I through VII, Cambridge, Massachusetts: Abt Associates, Inc., December 9, 1966, 124 pp. (Prepared for Division of Operations Analysis, NCES, U. S. Department of Health, Education and Welfare. Available through ERIC).

concluded that spillover effects due to migration were of considerable interest for equity considerations. "Population mobility and fiscal interdependence make education decisions in one part of the nation important to other, even distant parts."[28] In particular, he suggests that outmigration of educated people tends to lead to underinvestment in education in an area and inmigration can be thought of as a fixed benefit having no effect on marginal decisions. The latter conclusion, while it may hold for some forms of universal education, does not make sense in terms of professional or vocational education. An area that imports individuals with a particular skill and knows that it does, would be foolish not to consider the fact in its decisions.[29]

Income redistribution is another topic that has received some attention; this, too, is relevant to equity considerations particularly with regard to equitably distributing the subsidies (full cost of education less student charges) to the population of interest. Hansen and Weisbrod concluded that in California the distribution of subsidies actually favors upper income

[28] Weisbrod, B. A., External Benefits of Public Education: An Economic Analysis, Princeton: Industrial Relations Section, Princeton University, 1964, p. 117.

[29] Relevant to this is Holzman, A. G., "A Note on Public Education and Spillover Through Migration," Journal of Political Economy, October 1966, p. 524-5.

families.[30] Pechman, using the same data, concluded that the California system of public higher education is progressive, with a net redistribution from families with incomes above $12,000 to families with incomes below $12,000.[31] A more important criticism that he made is that Hansen and Weisbrod did not indicate the effect of higher education on the distribution of lifetime incomes (i.e., the long term redistributive effects). Clearly, such an analysis is beyond their reach, but the criticism stands.

Other issues that have been discussed are intergenerational benefits[32], dropout preventions[33], uncertainty[34], and social returns[35]. All in all, there are quite a few indirect benefits and effects that need to be considered in any thorough cost

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[30] Hansen, W. L. and B. A. Weisbrod, "The Distribution of Costs and Direct Benefits of Public Higher Education: The Case of California," Journal of Human Resources, Vol. 4, No. 2, Spring 1966, pp. 176-191.

[31] Pechman, J. A., "The Distributional Effects of Public Higher Education in California," Journal of Human Resources, Vol. 5, No. 3, Summer 1966, pp. 361-370.

[32] See Spiegelman, R. G., "A Benefit-Cost Model to Evaluate Educational Programs," (mimeo), Stanford: Stanford Research Institute, 1968; and Swift, W. J. and B. A. Weisbrod, "On the Monetary Value of Education's Intergenerational Benefits," Journal of Political Economy, Vol. 73, December 1965, pp. 673-9.

[33] Corazzini, A. J., "The Decision to Invest in Vocational Education: An Analysis of Costs and Benefits," Journal of Human Resources, Supplement, 1968, pp. 88-120.

[34] Packer, A. H., "Applying Cost-Effectiveness Concepts to the Community Health System," Operations Research.

[35] Bowman, M. J., "Social Returns to Education," International Social Science Journal, Vol. 14, No. 4, 1962, pp. 647-659.

benefit analysis of an educational system. Feldman and Singer have suggested that, given the lack of knowledge about many of these relationships, "public officials would be better advised to make their current allocation decisions on the basis of intuitive judgments of the magnitude of external benefits. At the same time, to guide future allocation decisions, they should support research on the measurement of externalities instead of studies which measure purely private benefits."[36]

Of Health Systems

Because medical education is closely related to health systems as well as education systems, we would like to consider some of the cost-benefit studies of the former that have been done in the past few years. These should help to define further the problems that must be faced in a thorough analysis of medical education. Review (or overview, if you prefer) articles by Jack Wiseman[37] and Herbert Klarman[38] discuss most of the major issues that arise in cost-benefit studies of health. Less

[36]Feldman, P. and N. M. Singer, "Benefit-Cost Analysis of Public Programs for Education and Training," Socio-Economic Planning Sciences, Vol. 14, 1970, pp. 283-289.

[37]Wiseman, J., "Cost-Benefit Analysis and Health Service Policy," Scottish Journal of Political Economy, Vol. 10, No. 1, February 1963, pp. 128-145.

[38]Klarman, H. E., "Present Status of Cost-Benefit Analysis in the Health Field," American Journal of Public Health, Vol. 57, No. 11, November 1967, pp. 1848-53.

adequate is the discussion by Crystal and Brewster.[39]

Since we will discuss specific aspects of a good number of the cost-benefit studies of health in our chapter on benefits, we will limit our discussion at this time to one important point, related to the distinction between health care as an investment good and health care as a consumption good. Even more than in education, this is an important distinction and it complicates any cost-benefit analysis. Essentially, it would be desirable to be able to determine the amount of health care obtained by individuals which cannot be related to increase productivity, etc. This amount, which presumably results in greater peace of mind for the individual, is typically thought of, not as an investment, but as consumption. Needless to say, while we can talk about this distinction, it is not presently possible to quantify it.

OTHER RELEVANT STUDIES

Although the cost-benefit analysis appears to be a better choice than does systems analysis as a tool for studying medical education, we are of the opinion that neither will suffice by itself at this time. Too little is known of the functional relationships

[39] Crystal, R. A. and A. W. Brewster, "Cost Benefit and Cost Effectiveness Analyses in the Health Field: An Introduction," Inquiry, Vol. 3, No. 7, December 1966, p. 3-13.

either within medical schools or linking medical schools to society to be able to implement a comprehensive systems analysis. And there are far too many intractable measurement problems facing the cost-benefit analyst.

More appropriate, we feel, are studies like those of Blumberg[40], Fein and Weber[41], and the Illinois Board of Higher Education[42], which are essentially compendia of smaller research studies that relate in varying degrees to the problems that face medical education decision makers. Each of these studies has facets similar to both systems analysis and cost-benefit analysis, but none of them falls neatly into either category. Actually, they are probably best categorized as economic studies since most of the analyses are of that type. This is to be expected since this is the primary tool that is available for quantifying parameters, etc., in any planning effort.

[40] Blumberg, M. S., "Medicine and Related Occupations," (mimeo), Berkeley: Office of Health Planning, University of California, 1969.

[41] Fein, R. and G. I. Weber, Financing Medical Education, New York: McGraw-Hill, 1971.

[42] Education for the Health Fields for the State of Illinois, 2 Volumes, Springfield, Illinois: Board of Higher Education, 1968.

CHAPTER 4

COSTS OF MEDICAL EDUCATION

Although data on expenditures are collected annually from every U.S. medical school by the Association of American Medical Colleges (AAMC), they are not published in a form useful for planning purposes.[1] In particular no attempt is made to allocate the expenditures to the appropriate educational programs. And the data are incomplete since they do not include expenditures for programs carried out in affiliated clinical facilities.

In view of the shortcomings of the published data, it is of some interest to investigate medical education cost patterns in some detail. The discussion that follows will consider each of the three major cost categories (operating, capital, and clinical) with particular attention on the problem of providing cost estimates on a program by program basis. The results of the three analyses will be brought together to provide in indication of who currently pays for medical education in the U.S.

Before proceeding we would like to caution readers about the use of the results of the analysis. Since most of the cost estimates presented in the paper are related to specific medical education programs, there may arise a temptation to assume or conclude that

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[1] Data on aggregate expenditures for all U.S. medical schools are published annually in the Education Issue of the <u>Journal of the American Medical Association</u>.

that they would hold true regardless of the size of the other programs. To the extent that program mix or size remains within the range at the schools used in the particular analysis, this is true. But it would be improper to apply these cost estimates to a hypothetical situation in which the program mix or size is outside the actual range observed in the analysis. Thus one could not, for example, apply these cost estimates to a model of a medical school that included only the medical undergraduate program. One could, however, apply them in an analysis of the effect of shifts in program emphasis, as long as the shifts did not carry the program mixes or sizes outside the range at the set of reference schools.

OPERATING COSTS

Despite a scarcity of information on program costs at medical schools, several studies have been published in the past few years which are relevant to the problem. The first of these, which appeared in the Journal of Medical Education in 1967,[2] provided the first published program cost estimates for medical education. It was based on an analysis of only one school; thus, it could hardly form the basis of any generalizations about program costs; but it is an important study and the numerical results have been used to derive the corresponding program costs in Table 1.

[2]Carroll, A. J. and Darley, W., "Medical College Costs," JME, Vol. 42, No. 1, January 1967, pp. 1-16.

In 1969 a second cost accounting analysis of medical school expenditures was published by the AAMC,[3] this time examining seven different medical schools. This analysis, as did the Caroll and Darley study, followed general procedures proposed by Carroll in an earlier report,[4] which outlined in some detail objectives and procedures for medical school program cost accounting studies. To protect the interests of the seven schools, the report does not give school by school summaries. The low, average and high of the seven program costs for each student category are provided, however, and these are included in Table 1.

Wing and Blumberg, in their study of medical school program costs,[5] have used a rather different approach. They have used regression analysis as a tool for allocating medical school expenditures to the major programs for 1964-65. While their assumptions (that all schools have the same program costs, that there be no joint consumption of expenditures, and that there be constant returns to scale) are clearly not completely true, they seem to be an acceptable first approximation.

Their study has several advantages over the two cost accounting studies. First, the results reflect operations at all four-year

[3] Campbell, T. J., "Program Cost Allocation in Seven Medical Centers: A Pilot Study," sponsored by AAMC and USDHEW, Evanston, Illinois: AAMC, 1969.

[4] Carroll, A. J., "A Study of Medical College Costs," Evanston, Illinois: AAMC, 1958, 188 pp.

[5] Wing, P. and M. S. Blumberg, "Operating Expenditures and Sponsored Research at U.S. Medical Schools: An Empirical Study of Cost Patterns," Journal of Human Resources, Winter 1971.

TABLE 4-1

MEDICAL SCHOOL PROGRAM COST ESTIMATES FROM THREE PUBLISHED STUDIES[a]

Study	Basis of Estimates	Year	Medical Undergraduates	Basic Science Students	Interns & Residents	Postdoctoral Students
Carroll & Darley	1 school	59/60	$ 1,905[b]	$ 3,093	$ 2,510	$ 3,771
Wing & Blumberg	82 schools	64/65	$ 2,834	$ 3,609[c]	$ 4,766[c]	--[c]
Wing & Blumberg	22 large state schools	64/65	$ 4,888	$ 6,670[c]	$ 5,395[c]	--[c]
"Seven Center"	Lowest of 7 costs	66/67	$ 2,800	$ 3,700	$ 5,300[d]	$ 2,200
"Seven Center"	Average of 7 costs	66/67	$ 3,700	$ 7,200	$ 7,000[d]	$11,400
"Seven Center"	Highest of 7 costs	66/67	$ 4,300	$11,700	$ 9,100[d]	$16,000

[a]These cost estimates do not reflect hospital related expenses. The sources of funds was not a consideration in obtaining any of these estimates.

[b]Note that the $825,330 "deficit" due to service programs has been excluded in this calculation. Carroll and Darley assigned this entire figure to undergraduate program which we feel is incorrect.

[c]Wing and Blumberg included postdoctoral basic science students with graduate academics, and clinical fellows with interns and residents.

[d]Includes a portion of intern and resident stipends.

Sources: Carroll, A. J. and W. Darley, op. cit.
Table 3 of Wing, P. and M. S. Blumberg, op. cit.
Campbell, T. J., op. cit.

medical schools, not just one or seven of them. Second, regression analysis implicitly accounts for interprogram teaching; to the extent that students teach each other, regression analysis properly reflects the effects on the program costs. For example, if residents teach undergraduates, regression analysis will cause the undergraduate programs to seem more expensive than would an accounting system that did not explicitly adjust for such interprogram teaching. Table 4-1 includes the cost estimates which are most relevant to this exposition.

The most important shortcoming of all of these studies is that they do not account properly for voluntary faculty. To emphasize that their impact may be substantial we note that the UCSF medical school estimated that voluntary faculty resulted in a reduction in medical undergraduate program cost of roughly $2,500 per student in 1967/68.[6] We suspect that this is substantially higher than the U.S. average, but until better data have been accumulated we can make no definitive statements. Another shortcoming is that all three studies include only direct costs. Indirect costs, principally foregone income of the students, are not accounted for.

Other studies of medical school program costs have been done but the results have not been made available to the public as yet. The

[6]Unpublished cost finding study at UCSF. The cost per medical undergraduate actually incurred was estimated to be roughly $5,000 per student despite this contribution.

AAMC is currently expanding its seven center study to include fourteen more medical schools; the University of California has recently obtained estimates of program costs for its medical schools at Los Angeles and San Francisco; and other medical schools are preparing similar analyses.

Cost Trends

Although it is not possible to derive accurate estimates of the trends in these operating costs over time from these studies, some rough calculations based on the data from the Wing and Blumberg study indicate that medical education program costs have been rising at almost 10 percent per year over the past decade.[7] Of the health related price indices published annually by the U.S. government (see Table 4-2), the Medical Care Service Index comes closest to matching this rate of increase though it has grown slightly slower than medical education program costs seem to have over this period.

The causes of this rather dramatic increase are not available from the data but several explanations are possible. Certainly some of

[7] Inflating the program cost estimates of Wing and Blumberg by 10 percent a year and applying the resulting coefficients to aggregate U.S. enrollments for the appropriate years yields estimates of aggregate U.S. expenditures which are close to actual figures as reported in the JAMA. We conclude that 10 percent is a reasonably accurate inflation factor.

TABLE 4-2

SELECTED PRICE INDEXES

1950 - 1969

Year	All Items	Medical Care	Medical Care Services	Physician Fees	Hospital Daily Service Charges
1950	83.8	73.4	71.7	76.0	57.8
1955	93.3	88.6	88.0	90.0	83.0
1960	103.1	108.1	109.1	106.0	112.7
1961	104.2	111.3	112.4	108.7	121.3
1962	105.4	114.2	116.2	111.9	129.8
1963	106.7	117.0	120.3	114.4	138.0
1964	108.1	119.4	123.2	117.3	144.9
1965	109.9	122.3	127.1	121.5	153.3
1966	113.1	127.7	133.9	128.5	168.0
1967	116.3	136.7	145.6	137.6	200.1
1968	121.2	145.0	156.3	145.3	226.6
1969	127.7	155.0	168.9	155.4	256.0

1957-59 = 100. Prior to 1964, figures exclude Alaska and Hawaii.

Source: Table 78, p. 62 and Table 523, p. 344 of Statistical Abstract of the U.S., 1970 edition; and equivalent tables in the 1967 edition.

the increase is due to general inflation, but this accounts for only about 2 percent increase annually. Perhaps medical schools have been increasing their expenditures per student and have improved the quality of their graduates correspondingly. Or perhaps productivity in medical education was not rising as rapidly as it was for the economy as a whole. Being more interested in the fact of the increase than the cause, we will not pursue this discussion further at this time.

Cost Incidence Patterns

Among the most important questions that arise about medical education is who should pay for it. While the current cost incidence patterns are not really relevant to these questions, it is of some interest to see who presently pays for medical education, if only because shifts in future financing patterns will probably be related to current patterns.

Tables 4-3 and 4-4 present cost incidence patterns for U.S. four-year public and private medical schools, respectively. Similar tables can be derived for other years from the medical school financial data provided annually in the JAMA Education issues. However, the public-private disaggregation is not available from these published data. Note that Tables 4-3 and 4-4 treat overhead on sponsored programs as a sponsored program item, whereas the JAMA tables treat it as a regular program item. Note also that the student contribution via tuition and fees shown in both tables is half that shown in the corresponding

JAMA table. This is because roughly half of tuition and fees are paid via Federal grants and scholarships.

TABLE 4-3

SOURCES OF SUPPORT FOR PUBLIC U.S. FOUR-YEAR

MEDICAL SCHOOLS IN 1964-65

Sources of Support	Sponsored Programs	"Regular" Programs	Total
Federal Government	$127,632,798 (85.1%)	$43,971,465 (24.2%)	$171,604,263 (51.8%)
State Government	0 (0%)	94,850,448 (52.3%)	94,850,448 (28.6%)
State & Local Government	3,984.588 (2.6%)	106,221 (0.0%)	4,090,809 (1.2%)
Private			
Industry	2,596,213 (1.7%)	0 (0%)	2,596,213 (0.7%)
Foundations	5,370,250 (3.5%)	1,417,390 (0.7%)	6,787,640 (2.0%)
Vol. Health Agencies	6,329,453 (4.2%)	0 (0%)	6,329,453 (1.9%)
Other or Not Itemized	2,041,846 (1.3%)	3,417,108 (1.8%)	5,458,954 (1.6%)
Medical School			
Endowment	1,504,554 (1.0%)	605,613 (0.3%)	2,110,167 (0.6%)
Reserves	0 (0%)	0 (0%)	0 (0%)
Students	0 (0%)	5,607,911 (3.0%)	5,607,911 (1.6%)
University	0 (0%)	5,725,913 (3.1%)	5,725,913 (1.7%)
Miscellaneous	388,346 (0.2%)	25,528,523 (14.0%)	25,916,869 (7.8%)
Total	$149,848,048 (100.0%)	$181,230,592 (100.0%)	$331,078,640 (100.0%)

NOTE: See Appendix A for sources and definitions

TABLE 4-4

SOURCES OF SUPPORT FOR PRIVATE U.S. FOUR-YEAR MEDICAL SCHOOLS IN 1964-65

Sources of Support	Sponsored Programs	"Regular" Programs	Total
Federal Government	$192,885,246 (81.3%)	$52,124.002 (33.2%)	$245,009,248 (62.1%)
State Government	0 (0%)	243,369 (0.1%)	243,369 (0.0%)
State & Local Government	7,575,949 (3.1%)	9,771,226 (6.2%)	17,347,175 (4.4%)
Private			
Industry	5,772,347 (2.4%)	0 (0%)	5,772,347 (1.4%)
Foundations	10,148,498 (4.2%)	1,652,751 (1.0%)	11,801,249 (2.9%)
Vol. Health Agencies	9,578,822 (4.0%)	0 (0%)	9,578,822 (2.4%)
Other or Not Itemized	6,618,889 (2.7%)	13,446,066 (8.5%)	20,064,955 (5.0%)
Medical School			
Endowment	3,323,537 (1.4%)	22,416,899 (14.2%)	25,740,436 (6.5%)
Reserves	0 (0%)	890,205 (0.5%)	890,205 (0.2%)
Students	0 (0%)	13,268,092 (8.4%)	13,268,092 (3.3%)
University	0 (0%)	16,950,991 (10.7%)	16,950,991 (4.3%)
Miscellaneous	1,081,837 (0.4%)	26,231,332 (16.7%)	27,313,169 (6.9%)
Total	$236,985,125 (100.0%)	$156,994,933 (100.0%)	$393,980,058 (100.0%)

Note: See Appendix A for sources and definitions.

CAPITAL COSTS

Possibly because capital expenditures and operating expenditures for medical (and most other) education usually come from different sources, they have come to be considered separately in the planning process. While they sometimes require separate consideration (particularly when studying project financing), this distinction can only lead to fragmented and inefficient planning. Both capital and operating expenditures are needed to educate physicians, and both must be considered when estimating the costs of future medical school expansion.[8]

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[8]Medical education is by no means unique in its shortage of information about capital utilization and costs; very few studies of capital have been done for any class of educational institutions. The most recent one is summarized in two papers by H. L. Dahnke and P. R. Mertins ("Inventory of Physical Facilities in Institutions of Higher Education: Fall 1968," Washington, D.C.: Office of Education, U.S. Dept. of HEW, 1970, 49 pp. [OE - 51007-68]; and "Distribution of Physical Facilities Among Institutions of Higher Education Grouped by Level, Control, and Enrollment Size: Fall 1968," Washington, D.C.: Office of Education, U.S. Dept. of HEW, 1970, 35 pp. [OE - 51018].) for the U.S. Office of Education. The first paper provides gross statistics and breakdowns about floorspace in U.S. colleges and universities, while the second contains more interesting statistics such as floorspace per FTE student. Given the general lack of data on capital utilization and costs in higher education these reports are extremely valuable, particularly to national and state level planners. However, because they use aggregate FTE student counts, they are of relatively little value to institutional-level planners whose most important administrative decisions relate to program mix. Two previous studies ("College and University Facilities Survey, Part 3: Inventory of College and University Physical Facilities," Washington, D.C.: Office of Education, U.S. Dept. of HEW, 1957, [OE - 5100]; and J. I. Doi and K. L. Scott, "Normative Data on the Utilization of Instructional Space in Colleges and Universities," Washington, D.C.: American Association of College Registrars and Admissions Officers, July 1960, 24 pp.) suffer from this same shortcoming, though they, too, were probably useful guides for long-range planners and budget analysts when they were more current.

Three important references[9] provide valuable insights into capital utilization and expenditures at U.S. medical schools, but they all fail in one important respect: they limit their discussion of students to medical undergraduates and fail to consider explicitly the other medical school programs. In other words, they discuss aggregate rather than program-by-program capital utilization and expenditures. A fourth report, sponsored by the NIH,[10] provides valuable data on research facilities at medical schools although the relation of these facilities to the educational programs is not discussed.

The analysis in this paper has two major objectives: to provide estimates of capital resources required by major medical school programs, and to outline for interested analysts a procedure for estimating capital costs which seem to have the potential for application in other situations. Absent from the discussion are financing (i.e., interest) costs. While this is certainly a legitimate cost category, we feel it is best left out of this paper. Anyone wishing to apply the capital cost estimates below to a particular planning problem must of course consider financing costs, but this can be done independently in a separate analysis.

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[9] Cheves McC. Smythe, "Developing Medical Schools: An Interim Report," Journal of Medical Education, Vol. XLII, No. 11, November 1967, pp. 991-1004; Medical Education Facilities, Planning Considerations and Architectural Guide, Washington, D.C.: Public Health Service, U.S. Department of HEW, 1967, 185 pp; and Cheves McC. Smythe, "Toward a Definition of Department Size," Journal of Medical Education, Vol. 45, September 1970, pp. 637-660.

[10] Health-Related Research Facilities in the United States in the Nonprofit Nonfederal Sector, 1968, Bethesda , Maryland: Westat Research, Inc.; April 15, 1969, 150 pp. [reprinted by U.S. Department of HEW].

Floorspace Utilization Estimation

Two methods for estimating floorspace utilization patterns at medical schools come to mind. One could observe the actual utilization patterns at the schools and assign space to programs according to its usage, or one could estimate floorspace utilization patterns empirically using multiple regression analysis. This second procedure, though it does require data on the total amount of floorspace at a set of medical schools and also data on the number of users (i.e., students and faculty) of various types at the same schools, requires no information about actual floorspace utilization patterns at medical schools. The multiple regression technique essentially imputes the utilization coefficients assuming that all schools have the same utilization patterns. By the same utilization pattern we mean:

1. All schools in a regression sample have the same floorspace utilization patterns (i.e., same types of students use same amounts of floorspace at all schools);
2. There is no joint utilization of floorspace among programs; and
3. Each of the floorspace utilization "processes" exhibits constant returns to scale (i.e., constant utilization at the margin for each class of user).

Although these assumptions are not completely justifiable, we feel that they are a reasonable first approximation to the true situation. We realize that different curricula may require rather different physical accommodations, but we suspect that medical school accreditation standards and professional licensure examinations foster some uniformity of curricula which would lead to similar floorspace utilization patterns at different schools.[11]

The joint utilization question is complicated by the possible distinction between original design of facilities and actual utilization. We suspect that most rooms are both designed and used with a single type of user in mind (e.g., the size of Instruction and Research labs is keyed to students even though faculty are also present). To the extent that either this is true or the current use (irrespective of original intent) is keyed to a single type of user, Assumption 2 seems to be reasonable. Note that sequential utilization of floorspace by different users, which we feel is more common than simultaneous utilization, does not violate Assumption 2. With regard to Assumption 3, we have no evidence either confirming or denying the existence of constant returns to scale.

Since we are unsure of the extent to which these assumptions are true, we must emphasize that our estimates are rather tentative. Readers should be extremely cautious in applying the numerical estimates in their own analyses; they are probably of the right order of magnitude but their precision is uncertain. Our earlier caveat about the application of the data is certainly applicable.

[11]Note that the trend toward more specialization, particularly at the medical undergraduate level (especially through increased numbers of elective courses) may make it more difficult to justify Assumption 1 in the future.

Variables Used in the Analysis

Before discussing the models in detail, we will itemize the different variables used in the analysis. Appendix C contains a complete list of the variables and their sources.

Dependent Variable:[12] The dependent variable used in this analysis is: Non-medical-care floorspace in assignable (net) square feet. This is essentially total floorspace less medical care floorspace. General use and residential floorspace are not included in the total because they are not directly related to the educational activities of medical schools.

Independent Variables: Since the principal objective of this study is to relate floorspace to its users, the independent variables are the counts of the different users, the students and faculty. The specific variables used in our analysis are:

(A) Medical Undergraduates, 1967-68

(B) Interns, Residents, and Clinical Fellows, 1967-68

(C) Basic Science Students, (at master, doctoral, and post-doctoral levels), 1967-68

[12] Our original intent had been to use as dependent variables several other of the floorspace types included in the Office of Education, Inventory of College and University Physical Facilities. However, after a few pilot models had been run, it was clear that disaggregation of floorspace beyond the category above would be inappropriate. Differences in reporting of actual utilization for types of floorspace are probably responsible for the poor models that resulted.

(D) Full-Time Faculty, 1966-67

(E) Voluntary Faculty, 1966-67

(F) Public Variable (= 1 if medical school is public, = 0 otherwise)

(G) Hospital Variable (= 1 if dental school is on campus, = 0 otherwise)

(H) Dental School Variable (= 1 if dental school is on campus, = 0 otherwise)

The first five of these variables represent the major users of floorspace who are involved in academic program. Ideally we would like to have had FTE counts for 1968-69 but had to settle for head counts in the earlier years because this was the best available data when the analysis was done. The three dummy variables (F, G, and H) are included to reflect possible differences in floorspace utilization at public and private schools, at schools that do and do not own a hospital, and at schools that may also serve dental schools.

The Samples: Our sample of medical schools was determined by the response to the OE survey. In our "All School" model we used the 55 complete responses out of the 76 that we received from OE.[13]

[13] OE received 76 out of a possible 89 responses from independent or affiliated four-year U.S. medical schools and forwarded them to us. Of these 76, eighteen were unusable because of lack of detail, and three reported floorspace in one or more major categories that was completely out of line with the rest of the schools. We were thus left with 55 usable responses. See Appendix D for a list of the schools.

For pilot models of medical care floorspace utilization we used a subsample of 23 of these 55 schools. We omitted the 27 schools that reported essentially no medical care floorspace and five other schools for which data on hospital workload were not available. We presume that these schools had access to medical care floorspace not reported in the survey, probably at affiliated hospitals and clinics.

The Data: Table 4-5 presents the means and standard errors of these variables for both the "complete" sample and the "medical care" sample. Table 4-6 presents the simple correlations between all pairs of the variables for the "complete" sample of schools.

TABLE 4-5

MEANS AND STANDARD DEVIATIONS OF VARIABLES USED IN STUDY OF MEDICAL SCHOOL FLOORSPACE UTILIZATION

Variable[a]	"Medical Care" Sample (23)		"All School" Sample (55)	
	Mean	Standard Error	Mean	Standard Error
Dependent				
(1) Non-Medical-Care Floorspace (1,000's of sq. ft.)	--	--	175.8	79.7
(2) Medical Care Floorspace (1,000's of sq. ft.)	185.1	57.8	--	--
Independent				
(A) Medical Undergraduates, 1967-68	426.8	160.0	421.0	154.0
(B) Interns, Residents, and Clinical Fellows, 1967-68	334.8	211.7	338.8	211.4
(C) Basic Science Students, 1967-68	143.9	93.8	106.9	80.3
(D) Full-Time Faculty, 1966-67	173.3[b]	60.4[b]	259.4	108.3
(E) Voluntary Faculty, 1966-67	435.5	371.4	455.7	309.4
(F) Public Variable (Dummy)	0.8	0.4	0.5	0.5
(G) Hospital Variable (Dummy)	--	--	0.6	0.5
(H) Dental School Variable (Dummy)	--	--	0.5	0.5
(I) Average Daily Census[c]	500.2	298.4	--	--
(J) Annual Outpatient Visits[c] (1,000's)	98.9	57.8	--	--

[a]See text for further explanation of variables.

[b]Full-time Clinical Faculty only.

[c]Used only in pilot models of medical care floorspace utilization to reflect patient care provided by the hospitals and clinics.

It is interesting to note in Table 4-6 that the independent variables, particularly the student variables, are not highly correlated. This is evidence that medical schools have rather different student mixes and should serve as a warning that cost per student figures based on only one type of student should be used with extreme caution.

In Table 4-7 the floorspace for our sample of 55 schools is compared with data presented by Smythe and the Public Health Service.[14] It would appear that our set of 55 established schools has substantially less floorspace available than either the 16 new schools reported on by Smythe or the Public Health Service guidelines. That the Public Health Service guidelines are larger is expected since they represent some sort of ideal allocation of floorspace. However, we are a little surprised to find that developing schools have more space than established schools. This may reflect a trend toward more facilities or larger programs at new schools or differences in reporting of definitions or it may be an indication of underreporting in the OE survey. More likely the new schools are building for the future and enrollments have not yet caught up with facilities. Or possibly, older schools were designed with smaller rooms, and "cultural" changes have occurred that have led to designing larger offices and labs. In the absence of definitions and information on program sizes at the 16 schools, we cannot determine the precise reasons for the difference.

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[14] Cheves McC. Smythe, (1967), op. cit.; and Medical Education Facilities, op. cit. Note that none of the 16 schools in Smythe's sample is included in our sample of 55 schools.

TABLE 4-6

SIMPLE CORRELATION COEFFICIENTS (r) FOR VARIABLES USED IN THE ANALYSIS OF NON-MEDICAL-CARE FLOORSPACE UTILIZATION AT 55 U.S. MEDICAL SCHOOLS AS OF FALL 1968

Variable	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
(A) Medical Undergraduates, 1967-68	1.00								
(B) Interns, Residents, Clinical Fellows, 1967-68	.28	1.00							
(C) Basic Science Students, 1967-68	.29	.41	1.00						
(D) Full-Time Faculty, 1966-67	.27	.70	.45	1.00					
(E) Voluntary Faculty, 1966-67	.25	.60	.08	.28	1.00				
(F) Public Variable	.23	.05	.18	-.18	-.02	1.00			
(G) Hospital Variable	.23	.09	.30	.19	.04	.46	1.00		
(H) Dental School Variable	.28	.26	.34	.19	.17	.05	.01	1.00	
(I) Non-Medical-Care Floorspace (1,000's of sq. ft.)	.27	.62	.66	.57	.36	.10	.06	.44	1.00

TABLE 4-7

COMPARISON OF ENROLLMENTS, FACULTY, AND FLOORSPACE AT 55 SCHOOLS WITH SMYTHE'S 16 SCHOOL AVERAGE AND 1964 PUBLIC HEALTH SERVICE GUIDELINES

	16 School Average	1964 PHS Report	55 School Average
Entering Medical Undergraduate Class	90.4	96	106
Interns, Residents, Clinical Fellows	N.A.	N.A.	339
Basic Science Students	N.A.	55	107
Full-Time Faculty	N.A.	135	260
Non-Medical-Care Space (1,000's of sq. ft.)	262[a]	234[b]	176
Medical Care Space (1,000's of sq. ft.)	292[a]	526[b]	185[c]

N.A. - Not Available

[a]Adjusted to net by taking 65 percent of gross square feet reported in Table 10 of Smythe, (1967), op. cit.

[b]Table 51, p.174 of Medical Education Facilities, op. cit.

[c]From 23 school "medical care" sample (Table 4-5).

Regression Models

Table 4-8 summarizes the principal regression model resulting from our investigation of floorspace utilization at U.S. medical schools.[15] It reports the model of non-medical-care floorspace utilization based on our "complete" sample of 55 schools.

The results are generally encouraging. The R^2 statistic of 0.67 is reasonably large and leads us to have some faith in the model. We offer the following observations on the model:

1. From Table 4-8 we see that the two principal users of non-medical-care floorspace appear to be Basic Science Students (468 square feet per student) and Full Time Faculty (230 square feet per full time faculty). The large coefficient for Basic Science Students is probably related to their participation in departmental and sponsored research. Voluntary faculty appear to use a significant but substantially smaller amount of non-medical-care floorspace (48 square feet per voluntary faculty). And Interns, Residents, Clinical Fellows (29 square feet per individual) and Medical Undergraduates (minus 26 square feet per student) appear to use even less. The negative coefficient for Medical Undergraduates indicates

[15] We have used the regression program in the Ariel statistical package which is described by Phillip Deuel, "Ariel Reference Manual," Berkeley: Computer Center, University of California, April 1968.

TABLE 4-8

ESTIMATED UTILIZATION OF NON-MEDICAL-CARE FLOORSPACE AT U.S. MEDICAL SCHOOLS AS OF FALL 1968

Dependent Variable: Non-Medical-Care Floorspace (net square feet)

Number of Observations: 55 (medical schools)

R^2: 0.67

Mean of Dependent Variable: 175,828 (net square feet)

Standard Error of Estimate: 49,917 (net square feet)

Independent Variable	Regression Coefficient	Standard Error	t Statistic	Significance Level
Constant	39,505	24,983	1.6	0.12
Medical Undergraduates	-26	50	-0.5	0.60
Interns, Residents, Clinical Fellows	29	60	0.5	0.64
Basic Science Students	468	105	4.4	0.00*
Full Time Faculty	230	106	2.2	0.04
Voluntary Faculty	48	29	1.6	0.11
Public School	29,717	17,745	1.7	0.10
Hospital Owned by School	-38,634	17,160	-2.3	0.03
Dental School on Campus	27,998	14,838	1.9	0.07

*Less than 0.005

that, all other things being equal, schools with large Medical Undergraduate programs have less floorspace than other schools.[16]

2. Although the t-statistics for Interns, Residents, Clinical Fellows (0.5) and Medical Undergraduates (-0.5) in this model are small, the standard errors indicate that confidence bands are roughly the same width for these variables as for the other student and faculty variables.

3. Table 4-8 indicates that other things being equal medical schools that own a hospital have nearly 40,000 fewer square feet of non-medical-care floorspace than do schools that do not own a hospital. It also indicates that other things being equal public medical schools have about 30,000 more square feet of non-medical-care floorspace than do private schools, and also that medical schools with dental schools on the same campus use about 28,000 more square feet of non-medical-care floorspace than do schools without a dental school on campus. Although the reason for these findings is not indicated by this empirical analysis, several plausible explanations are available. The hospital and dental schools effects are very likely due to sharing of facilities (e.g., non-medical-care functions being carried

[16] We note in Appendix C that classroom space is probably understated for some schools. Since Medical Undergraduates are the principal users of classroom space, this may partially explain the negative coefficient.

out in owned hospital facilities, and use of medical school space by dental students on campus). The public school effect is less obvious but may be due to easier access to capital financing by public schools in the past which led to larger floorspace allotments than at private schools

4. The constant in Table 4-8 provides limited evidence of economies of scale with regard to floorspace at medical schools. However, the t-statistic is only moderately significant and thus we can infer little about this important subject from this analysis. We suspect that the constant reflects such things as the dean's office and other central facilities and offices not attributable to specific programs.

Before concluding, we would like to mention some observations based on pilot models not summarized in this paper:

5. In a pilot model in which Medical Care Floorspace was the dependent variable and the "medical care" sample of 23 schools was used, we observed that Interns, Residents, and Clinical Fellows appeared to be the major users of medical care space. Medical Undergraduates and Basic Science Students also appeared to be significant users of medical care space. This model is not presented here because even for those 23 schools in our sample, all of which owned a hospital, the medical care floorspace is

underreported. This is because nearly all medical schools are affiliated with and maintain teaching programs in several affiliated hospitals and clinics (see Appendix F). Thus an adequate study of the utilization of medical care floorspace on a program by program basis would require an analysis of hospital space rather than medical school space. Since such data are not available, this aspect of the analysis must be deferred.

6. Medical schools reporting much less Instruction and Research Laboratory space than expected (as indicated in the residual plot of a model in which Instruction and Research Laboratory space was the dependent variable) typically had substantial (more than 50,000 square feet) amounts of Organized Research space. Conversely, schools reporting much more Instruction and Research Laboratory space than expected typically had little or no Organized Research space. We took this as an indication of substitutability of these two types of space, and we combined them in all subsequent models.

7. As an indicator of age of facilities a dummy variable to indicate schools which had been built or moved since World War II was included in a few pilot models. This variable was not very significant in any of these models, but indicated that schools built or moved since World War II have somewhat less non-medical-care floorspace and somewhat more medical care floorspace than do other schools.

It is interesting to apply the estimate coefficients of Table 4-8 to the average program sizes of Table 4-5 to obtain an estimate of the "average" allocation of non-medical-care floorspace at the 55 U.S. medical schools in our sample. Table 4-9 presents these estimates. Not surprisingly, faculty appear to be the largest users of non-medical-care floorspace. Students appear to use about one fourth of the total space. The remaining fourth, attributable to neither faculty nor students, is probably related to central functions such as administration.

Capital Cost Estimation

Before we can estimate the capital costs for the major programs, we must allocate the faculty space among the programs. Ideally this allocation should be based on an accurate faculty time study. Lacking such a study, we will allocate the space according to the percentage of operating expenditures attributable to each program.[17] The results of this allocation are presented in Table 4-10.

The final step in the cost estimation procedure is to translate the floorspace utilization coefficients of Table 4-10 into capital cost estimates. Using construction cost estimates as discussed in

[17]This is reasonable if one is willing to assume that faculty effort is proportional to operating expenditures and that floorspace utilization is proportional to faculty effort. Both seem like reasonable first approximations.

TABLE 4-9

AGGREGATE UTILIZATION OF NON-MEDICAL-CARE FLOORSPACE AT AN "AVERAGE" U.S. MEDICAL SCHOOL BASED ON REGRESSION MODEL COEFFICIENTS OF TABLE 4-6

Class of User	Average Net Square Feet[a]	Percent of Floorspace
Faculty (Full time and Voluntary)	81,500	46.3%
Students	49,900	27.8%
Unallocated [b]	45,500	25.8%
	175,800	100.0%

[a] Regression Coefficient from Table 4-8 × Average Program Size

[b] Contribution due to constant and dummy variables

TABLE 4-10

ESTIMATED FLOORSPACE UTILIZATION PER PROGRAM OUTPUT (ENROLLED STUDENT OR $ OF SPONSORED RESEARCH) FOR MAJOR MEDICAL SCHOOL PROGRAMS

Program	Estimated Direct Floorspace Utilization per Program Output[a]	Estimated Share of Average Faculty Floorspace per Program Output[b]		Estimated Total Floorspace Utilization per Program Output
Medical Undergraduate	-11[c]	+ 24	=	13
Intern, Resident, Clinical Fellow	29	+ 36	=	65
Basic Science Student	468	+ 26	=	494
Sponsored Research (10,000's)	--	+101	=	101

[a]From Table 4-8.

[b]Computed as follows: $\dfrac{\text{Average Total Net Sq. Ft. for Faculty (Table 4-9)} \times \text{Percent of Expenditures for Program}}{\text{Average Program Size (Table 4-5)}}$;

Percentages of expenditures are taken from Table 4 of Wing and Blumberg, op. cit.:

Undergraduate	12.6%
Intern, Resident, Clinical Fellow	15.0%
Basic Science Student	3.4%
Sponsored Research	62.2%

with $5,000,000 as mean of Sponsored Research.

[c]Adjusted by adding 15 square feet to reflect classroom space omitted from OE survey responses. This is a reasonable estimate of classroom space per undergraduate. The effect of this adjustment on the cost estimate is negligible.

Appendix E,[18] we obtain the estimated capital costs per program unit in Table 4-11. To emphasize the uncertainty in these estimates we have included standard errors for these coefficients as well. Thus, for example, the standard error of the cost for annualized undergraduate capital costs is $255. Since the point estimate for this cost is $65, the 68 percent confidence interval (± one standard error) for the annualized capital cost is -$190 per undergraduate per year to +$320 per undergraduate per year.

Table 4-12 outlines the procedure followed to adjust the standard errors to reflect the process of allocating the faculty space.

Cost Incidence Patterns

Data on cost incidence patterns for medical school construction, though available, are not entirely adequate. As can be seen from Table 4-13, a substantial proportion of recent funding has been attributed to universities. While this may be adequate for some purposes, it is not adequate in the current context. Universities are not legitimate sources of funds; they are only intermediaries. Later in the chapter, when we estimate an overall cost incidence pattern, we will make some assumptions about the sources of university funds. For now we will be satisfied with the published data.

[18] By using current construction costs we arrive at capital cost estimates that are related to total replacement of facilities. This makes this analysis more relevant to costing out of new and proposed schools and programs than to existing programs in which facilities already exist.

TABLE 4-11

ESTIMATED TOTAL AND ANNUALIZED CAPITAL COSTS FOR MAJOR MEDICAL SCHOOL PROGRAMS BASED ON FLOORSPACE UTILIZATION ESTIMATES

Program	Estimated Total Capital Cost per Enrolled Student[a]	Estimated Annualized Capital Cost per Program Unit[b]
Medical Undergraduate	\$ 2,171 ± 8,517	\$ 65 ± 255
Intern, Resident, Clinical Fellow	\$10,855 ± 10,354	\$ 325 ± 310
Basic Science Students	\$82,498 ± 17,535	\$2,470 ± 525
Sponsored Research (\$10,000's)	\$16,867 ± 8,350	\$ 505 ± 250

NOTE: The tabulated figures are: point estimate ± one standard error. This represents a 68 percent confidence interval about the true cost (i.e., with probability 0.68 the true value lies within the stated interval). The cost standard errors are computed by applying cost estimates to the space standard errors in Table 4-12.

[a]Based on \$167 per assignable square foot of space (see Appendix E).

[b]Based on \$5 per assignable square foot of space per year.

TABLE 4-12

ESTIMATED STANDARD ERROR OF FLOORSPACE UTILIZATION COEFFICIENTS

FOR MAJOR MEDICAL SCHOOL PROGRAMS

Program	Estimated Variance of Coefficient[a]	Estimated Variance Due to Faculty[b]	Estimated Total Variance[c]	Estimated Standard Error
Medical Undergraduate	2,500	124	2,624	51
Intern, Resident, Clinical Fellow	3,600	219	3,819	62
Basic Science Students	11,025	34	11,059	105
Sponsored Research	(0)	2,548	2,548	50

[a]Based on Table 4-8.

[b]Assuming that Full-time Faculty and Voluntary Faculty are independent so that we can use Var (Fac) = Var (FT Fac) + Var (Vol Fac). Here Var (Fac) = 259 × Var (FT Fac) + 456 × Var (Vol fac) = 3,293,620. We use the fact that Var (aX + b) = a^2 Var X. Here "a" represents the shares of faculty space allotted to the four programs. Also assume that each student gets an equal share of the program's variance.

[c]Assuming for simplicity that student use of space and faculty share are independent, which allows us to add the two variances to get the estimated total.

TABLE 4-13

SOURCES OF FUNDS FOR MEDICAL SCHOOL CONSTRUCTION

FOR RECENT YEARS ($ MILLIONS)

Source	1966/67	1967/68	1968/69	1969/70
Federal	$ 93.1 (28.2%)	$152.4 (43.5%)	$192.5 (39.0%)	$181.3 (32.0%)
State	106.4 (32.1%)	72.3 (20.7%)	143.7 (29.0%)	165.8 (29.3%)
University	57.4 (17.4%)	60.7 (17.4%)	95.2 (19.0%)	160.3 (28.3%)
Private	54.2 (66.5%)	48.0 (13.7%)	34.9 (7.1%)	30.9 (5.6%)
Other	19.3 (5.8%)	16.3 (4.7%)	28.8 (5.9%)	26.9 (4.8%)
Total[a]	$330.5	$350.0	$495.1	$556.5
New Const. Planned[b]	$165.8	$188.4	$293.2	$383.3

[a]Total construction (completed and in progress)

[b]New plans excluding carryovers. Includes both construction and equipment.

Source: Figure 1, page 1996 of JAMA, Vol. 206, No. 9, November 25, 1968 and comparable Figures in 1967, 1969, and 1970 JAMA education issues.

A few tentative observations on the data in Table 4-13 are in order. Trends, if any, are not obvious, but the well documented federal cutbacks show quite clearly. State contributions remain stable proportionately although they have risen absolutely. Private contributions have fallen substantially, even in absolute terms.

Although time lags are difficult to estimate, it would appear that medical school construction will continue at a brisk pace for at least a few more years; planned construction has risen substantially from 1966 to 1970. This is not surprising in light of the growth of both new and established schools across the U.S. in recent years.

CLINICAL COSTS

Since a substantial portion of medical education is on-the-job training in clinical settings, it is of interest to estimate the resources required for this important part of the education process. Unfortunately, current accounting procedures in teaching hospitals and clinics seldom disaggregate expenses attributable to teaching from expenses attributable to patient care. Presumably, any excess cost (or income) attributable specifically to teaching should be included in (or subtracted from) estimates of the teaching costs at the medical schools.

Although substantial original analysis is beyond the scope of this project, we will review the literature and present a few tentative calculations that seem relevant to the problem. We hope to demonstrate the need for further research of this subject matter as well as provide preliminary estimates of clinical teaching costs.

Relevant Quantitative Studies

Before proceeding, it would be appropriate to mention several references which provide solid, qualitative background material regarding teaching hospitals and clinical training of medical students. Of particular importance is a series of articles assembled by H. E. Whipple[19] which cover with insight such subjects as the objectives of, research and change in, operations of, and planning for clinical teaching programs for medical schools. Supplementary background material is available in several other references.[20] None of these offers any quantitative estimates of the costs of running these clinical education programs.

[19] Whipple, H. E. ed., "Medical Schools and Teaching Hospitals: Curriculum Programming and Planning," Annals of the New York Academy of Sciences, 128, 2, September 27, 1965, pp. 457-720.

[20] Knowles, J. H., The Teaching Hospital: Evolution and Contemporary Issues, Cambridge: Harvard University Press, 1966, 152 pp.

Sheps, Cecil G., et. al., Medical Schools and Hospitals, Interdependence for Education and Service, prepared for participants in 2nd Institute on Administration: Medical School-Teaching Hospital Relations, December 6-9, 1964, Evanston, Illinois: AAMC, 1964, 107 pp. + 55 page notebook.

(Contd.)

Any of three fundamental approaches could be used in an analysis of clinical costs of medical education:

a. Individual case studies to determine current resource utilization patterns at particular institutions.

b. Empirical studies to estimate "average" resource utilization patterns at particular institutions.

c. Constructive analysis to estimate resource utilization patterns under some hypothetical set of circumstances.

In nine relevant studies only the last of these approaches is not represented, undoubtedly because so little is known of the objectives, functions, etc. of teaching hospitals.[21] Each of the other two has been used in several of the studies which are summarized below.

1. One study providing data on the additional costs of clinical operations attributable to teaching was done by W. J. Carr and P. J. Feldstein.[22] They used regression

[20] (Contd.) Blumberg, M. S., "The Selection of Teaching Patients," (mimeo), Berkeley: Office of Health Planning, University of California, March, 1969, 31 pp.

[21] The AAMC in preparing its "seven center study," analyzed teaching costs at several university teaching hospitals. They did not include their findings in the final report because of reservations they had about the validity and interpretation of their results.

[22] "The Relationship of Cost to Hospital Size," Inquiry, IV, No. 2, June 1967, pp. 45-65.

analysis in a cross section analysis of hospital costs at 3,147 U.S. voluntary short-term general hospitals in 1963. Among the independent variables included in their analysis were: number of internship and residency programs at hospital; number of interns and residents; and a dummy variable to indicate whether hospital has a medical school affiliation. Their dependent variable was total cost.

Their analysis provided the following cost estimates:

$ 55,347	per Internship and Residency program
$ 5,034	per Intern and Resident
$164,796	if hospital has medical school affiliation.

These coefficients were quite significant ($t > 4$) and indicate that teaching programs lead to additional patient care expenses.

2. In an analysis of a single (anonymous) hospital clinic, Vincent Taylor and Joseph Newhouse[23] indicate that the estimated teaching cost varies from service to service. Teaching results in higher costs in some services and lower costs in others (See Table 4-14).

3. A third study bearing on this subject was conducted by

[23] "Improving Budgeting Procedures and Outpatient Operations in Nonprofit Hospitals," Santa Monica: RAND (RM-6057/1), January 1970.

TABLE 4-14

TEACHING COSTS AT A HOSPITAL OUTPATIENT CLINIC

Clinic Service	Teaching Cost Per Visit
Allergy	$ - 2
Cardiac	9
Dermatology	- 3
ENT	- 3
Emergency	-10
Eye	11
Medical	3
Neurology	1
Pediatric	0
Psychiatry	5
Average:	$ - 2

Source: Table 4, page 20 of Taylor, V. D., and J. P. Newhouse, op. cit. Note that these are "hypothetical but representative" of other outpatient clinics. The table indicates that the teaching programs subsidize the clinic on the average.

M. L. Ingbar and L. D. Taylor.[24] They used regression analysis to study costs at 72 hospitals in Massachusetts. They found that cost per available bed day (beds times days for a year) were higher for most services at teaching hospitals, based on their 1958-59 models. It is difficult to generalize their graphical presentation, but it appears that cost per available bed day runs 20 to 25 percent higher at teaching hospitals than at other hospitals. They stated that "only in operating the pharmacy and in providing medical and surgical supplies, were teaching hospitals more efficient in 1959 than would be predicted by the equations for the community hospitals."[25] Since all medical schools in Massachusetts are private, the observed results may not be representative of the rest of the U.S.

[24] Hospital Costs in Massachusetts: Cambridge: Harvard University Press, 230 pp., 1968.

[25] Ibid., p. 90.

4. A study by L. P. McCorkle[26] of hospital utilization indicates that staff patients (i.e., teaching patients) in medical specialty services had longer stays than did private patients at a large urban university-affiliated general hospital. She noted that the mean stay for teaching patients was about 20 percent longer than for private patients. She went on to note that the difference in stay varied for different services, and that there were inconsistencies in the definition of admission for some services which explain part of the difference. She was unable from her analysis to determine the reason for the difference. For surgical specialties the differences was much less pronounced. McCorkle does not mention this, but it is possible that the observed result may be due to additional time required for teaching done in conjunction with the treatment.

5. In another study of hospital utilization Riedel and Fitzpatrick provide some additional evidence that teaching hospitals involve longer stays for patients.[27] Their

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[26] "Utilization of Facilities of a University Hospital: Length of Inpatient Stay in Various Departments," Health Services Research, I, No. 1, Summer 1966, pp. 91-114.

[27] Riedel, D. C. and T. B. Fitzpatrick, Patterns of Patient Care, Ann Arbor: University of Michigan, 1964, 292 pp.

study reports multiple classification models which indicate that large hospitals (not all of which have teaching programs, but which include all teaching programs in Michigan) have longer stays. They note, as did McCorkle, that results vary for different diagnoses (they looked at six diagnoses), but stays were longer in larger hospitals for all of them. The fact that teaching hospitals have longer stays does not imply that they are inefficient or cost more to operate, although that is one possible explanation. The longer stays may well be due to more severe cases.

6. Another study that bears on this subject was reported by J. R. Lave and J. B. Lave.[28] In regression models to explain the variance in cost inflation rates across hospitals, they found that "hospitals with advanced programs averaged a 1.3 percentage point (per year) higher rate of cost inflation than hospitals with no teaching programs; and hospitals with regular teaching programs averaged an 0.9 percentage point (per year) higher inflation than hospitals with no teaching programs."[29]

7. An accounting study at Rhode Island Hospital[30] showed that the direct cost of maintaining a 20 intern, 62 resident

[28]"Hospital Cost Functions: Estimation of Cost Functions for Multi-Product Firms," revised August 1969 (mimeo), to appear in the American Economic Review.

[29]Ibid., p. 15.

house officers program was $293,327, or $3,577 per house officer in 1959. This included the $1,725 average stipend paid to these "students." It is particularly disappointing that the study made no attempt to estimate the "hidden" costs of the house officer programs due to extra lab and diagnostic procedures, longer hospital stays, etc. This is not an easy job, but it is essential if accurate estimates of the costs are to be obtained.

8. In a similar study, P. J. Voigt[31] estimated that the direct cost to the hospital per intern per year was $3,300 in 1959/60. He, too, made no attempt to estimate the indirect costs attributable to the internship program. In a companion time study (which is technically rather poor) he noted that in the one time period at the one hospital, interns spent 13 percent of their time on education and 70 percent on patient care and standby.

9. Aside from generally higher expense rates, teaching hospitals and clinics probably involve additional costs to the state. In particular, there may be a need for subsidies from the state to assist teaching patients in financial need. The Annual Report of the UCLA Hospital

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[30] Pratt, O. G. and L. A. Hill, "The Price of Medical Education: A Dissection of One Hospital's Expenditures," Hospitals, 34, August 1, 1960, pp. 44.

[31] "A Study in the Service Aspect and the Direct Costs of an Internship Program in a Private Hospital," Minneapolis: Program in Hospital Administration, University of Minnesota, 1960.

> and Clinics indicates that nearly 16 percent of the total patient charges in 1968-69 were assumed by the state in this manner. And although this represents a decreasing portion of the total (in 1963-64 the portion was over 30 percent) it still amounted to 2.9 million dollars.[32]

Although the objectives, methods, and findings of these studies are far from uniform, they all seem to indicate that teaching programs at hospitals do result in additional expenditures. They also indicate that the relative costs vary substantially among the medical specialties. There certainly seems to be a need for detailed cost accounting studies to estimate these clinical costs more accurately and to clarify the surrounding issues.

Clinical Resource Requirements

A somewhat different approach to this problem was used in an empirical analysis of clinical resource utilization of internship and residency programs by Mark Blumberg, formerly Director of Health Planning at the University of California. The primary objective of this pilot study was to determine how many patients (inpatients in particular) are required to maintain different house officer programs. It was hoped that this information could be applied in an analysis of the possible need for new or expanded hospital facilities for the three

[32]"Annual Report, July 1, 1968 to June 30, 1969, UCLA Hospital and Clinics," Los Angeles: University of California.

new University of California medical schools. Table 4-15 presents the minimum, median, and maximum specialty admissions per approved residency for five types of hospitals for the five major specialties for which admissions seem to be the important criterion for clinical experience.[33]

Figure 4-1 presents some complementary information in much the same spirit. The figure is a frequency distribution of "hospital beds at major affiliate hospitals per student" for 85 medical schools. It indicates in terms of hospital beds the implications of medical school programs. Hospitals that have major affiliations were chosen because they have rather close ties with schools and encompass most of the clinical training experiences at the schools. Ideally only those beds in the sixteen specialties for which beds are an important clinical resource[34] should have been included, but for simplicity all the beds at the hospitals are included in the totals.[35] The error introduced by this approximation is probably quite small since the other specialties are assigned very few beds at most hospitals. Also since the hospitals are major affiliates, the influence of the medical school often extends

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[33]Admissions is not the important statistic for some specialties (e.g., radiology and pathology). Note that the figures are based on approved (rather than filled) residencies which means that they are understated by roughly 25 percent.

[34]Dermatology, General Practice, Internal Medicine, Neurosurgery, Neurology, Obstetrics-Gynecology, Opthalmology, Orthopedic Surgery, Otolaryngology, Pediatrics, Pediatric Cardiology, Plastic Surgery, Psychology, Surgery, Thoracic Surgery, Urology.

[35]Appendix E contains the summary worksheets for interested analysts.

TABLE 4-15

SPECIALTY ADMISSIONS PER APPROVED RESIDENCY OFFERED IN 1967-68 BY

SPECIALTY AND HOSPITAL OWNERSHIP

Specialty	Type of Hospital				
	Voluntary Non-Profit	Charity, City, District, County	State Owned	Veteran's Administration	Multi-Service
Pediatrics	208 (39) 65-2439	244 (15) 97-735	161 (21) 69-613	- (0) -	227 (23) 118-704
Internal Medicine	256 (39) 75-1111	164 (28) 63-543	139 (12) 70-926	149 (14) 52-407	256 (41) 92-862
Obstetrics-Gynecology	417 (35) 125-1695	455 (21) 169-1099	294 (24) 191-595	- (0) -	233 (24) 195-1205
General Surgery	189 (35) 96-1493	122 (22) 59-1786	96 (10) 41-195	111 (11) 70-242	195 (49) 87-1370
Orthopedic Surgery	143 (27) 46-490	120 (18) 23-433	119 (19) 53-334	115 (12) 60-259	196 (26) 46-917

NOTE: Table entries are: Median
(No. of hospitals)
Range

Sources: "Directory of Approved Residencies," Directory of Approved Internships and Residencies, 1966 (Chicago: American Medical Association, Revised to June 30, 1966), p. 129-279.

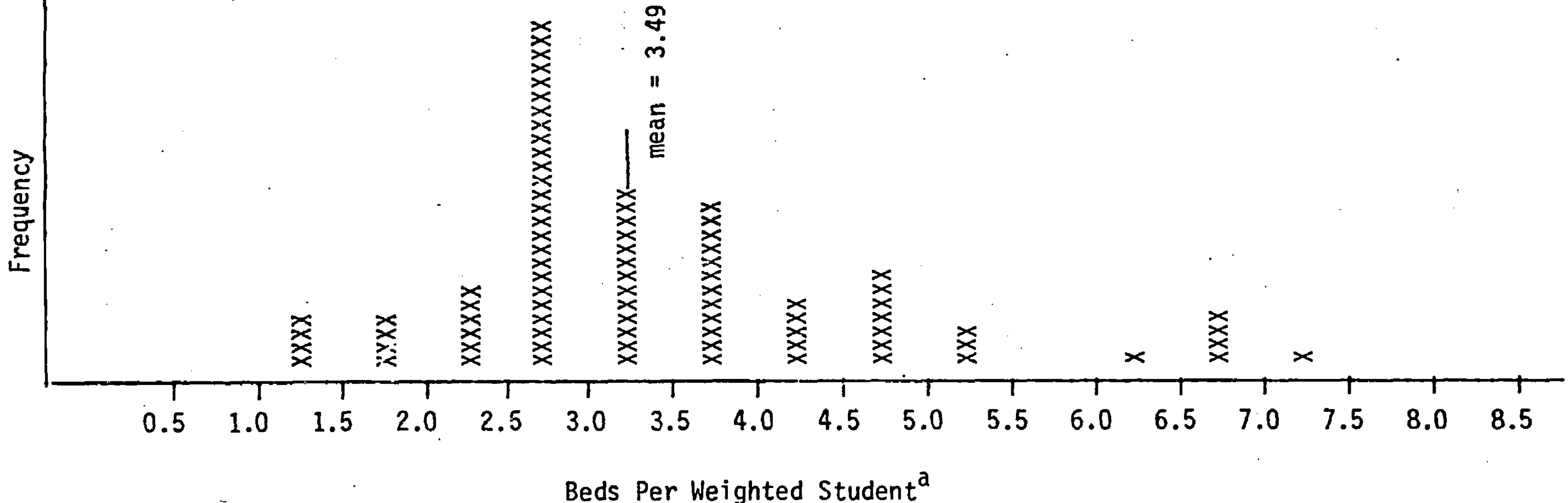
"Hospitals - Guide Issue, Part 2," Journal of American Hospital Association, XL, No. 15 (August 1, 1966), pp. 18-244.

Unpublished tables, Office of Health Planning, University of California, Berkeley, 1969.

FIGURE 4-1

HOSPITAL BEDS PER WEIGHTED STUDENT FOR 85

MEDICAL SCHOOLS IN THE U.S.



[a]Ratio of total beds in all major affiliate hospitals to the sum of one half of the total medical undergraduates at the school plus all interns and residents assigned to the hospitals.

beyond the specialty services which have house-staff programs.

The students included in the analysis are: residents in the sixteen specialties, all interns at each major affiliate hospital, and one half of the medical undergraduates of the medical school. This accounts for all of the students likely to interact with patients that generally require beds. Only half of the undergraduates are included since only during the last two years (of the traditional curriculum) do undergraduates spend significant amounts of time in hospital settings.

We conclude from Figure 4-1 that for each clinical student (as defined above) a medical school must provide <u>roughly</u> 3.5 beds in major affiliate hospitals for his clinical experience. A similar index derived by Smythe[36] is summarized in Figure 4-2. We feel that his index, though possibly more useful for departmental planning, is less sound as an overall planning guide. He considers only beds in surgical, medical and pediatric services and students assigned to them. One of the major difficulties in this procedure is that undergraduates in particular are assigned to other services as well. He adjusted for this by counting only third-year undergraduates.

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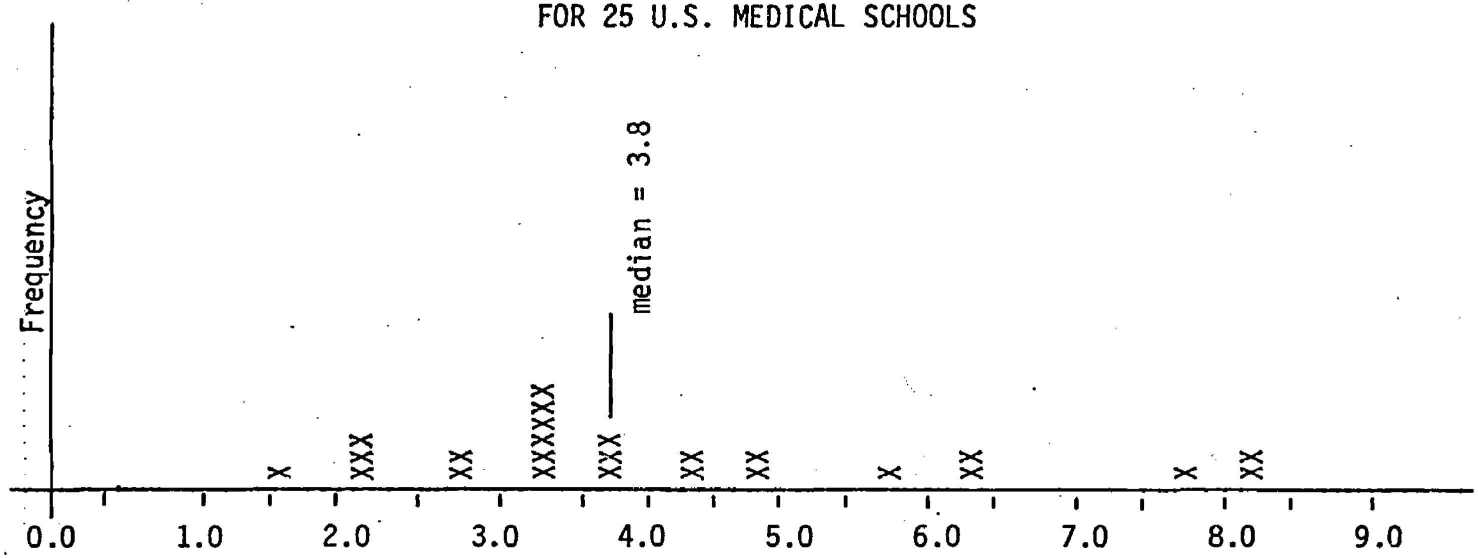
[36] "Toward a Definition of Department Size," <u>JME</u>, September 1970, pp. 637-60.

FIGURE 4-2

HOSPITAL BEDS PER WEIGHTED STUDENTS

FOR 25 U.S. MEDICAL SCHOOLS



Ratio of Teaching Beds[a] to Students[b]

[a]Juniors, Residents and Interns

[b]Assigned to Surgery, Medicine and Pediatrics

Source: Table 9, page 655 of Smythe, C. McC., "Toward a Definition of Department Size: A Study Based on Six Departments in Twenty-five Medical Schools," JME, Vol. 45, No. 9, September 1970.

At first glance these tabulations and histograms may seem quite relevant to planning for clinical facilities to support house officer programs; they certainly supplement the guidelines established by the different specialty boards.[37] But neither of these approaches answers what appear to be the most important questions facing medical education planners, specifically, how many admissions or beds ought there be for each resident or residency program. It is clear that acceptable house officer programs can be and are run in many different ways. Some provide a highly structured sequence of experiences for the student; others leave him to find his own way in a busy emergency clinic. Some emphasize research, others clinical procedures. With the possibility of such diversity among programs, empirical data such as this seem useful for answering only very general questions (e.g., are additional clinical facilities likely to be required to support a new house officer program?). We would not recommend that they be used as firm quantitative guides.

Preliminary Cost Estimation

Before concluding we would like to present a few preliminary calculations to estimate the significance of clinical costs relative to operating and capital costs at medical schools. To do this we will compare estimates of the clinical costs for a hypothetical house officer program to the medical school operating and capital costs.

[37] As reported for each specialty in "Directory of Approved Residencies," Directory of Approved Internship and Residencies, Chicago; AMA, revised each year.

Suppose a medical school has 240 interns and residents "studying" in six different affiliated hospitals. Suppose further that the total number of internship and residency programs at these six hospitals is thirty-six.[38] The clinical costs associated with these programs based on the Carr and Feldstein[39] coefficients would be:

240 house officers	×	$ 997	=	$ 239,280
36 programs	×	$ 55,347 per program	=	$1,992,492
+ 6 affiliations	×	$174,796 per affiliation	=	$1,048,776
Estimated Total Clinical Cost:			=	$3,280,548

> Note that we have omitted $4,037 per intern and resident as an estimate of the stipends paid by the hospitals to the house officers for their services. Unfortunately the AMA tabulates salaries for only interns and first-year residents (see Table 4-16). We chose the higher of these two figures to account for what must be larger stipends for advanced residents.

It is unlikely that all of this is attributable to house officer programs, but perhaps the parts attributable to the individuals and programs are. This amounts to nearly $9,300 per house officer in education related hospital expenses which is substantially higher than the estimated contribution by the medical school of about

[38]This would not be an unusual affiliation pattern. See Sheps, C. G., et. al., "Medical Schools and Hospitals," Journal of Medical Education, XLII, No. 9, Part 2 (September 1965) for a discussion of affiliation patterns.

[39]Op. cit.

TABLE 4-16

AVERAGE ANNUAL SALARIES FOR INTERNS AND FIRST-YEAR RESIDENTS FOR RECENT YEARS

Year	Interns			First-Year Residents		
	Total Group	Affiliated Programs	Nonaffiliated Programs	Total Group	Affiliated Programs	Nonaffiliated Programs
1958-59	$ --	$1,860	$2,376	$ --	$ --	$ --
1959-60	--	1,992	2,484	--	--	--
1960-61	--	2,136	2,628	--	2,520	2,940
1961-62	2,796	2,292	2,988	3,300	2,776	3,604
1962-63	3,039	2,625	3,485	3,684	3,398	4,037
1963-64	3,425	3,053	3,678	4,037	3,739	4,309
1964-65	3,529	3,245	3,707	3,989	3,775	4,163
1965-66	3,797	3,578	4,071	3,931	3,818	4,059
1966-67	4,322	4,139	4,521	4,295	4,095	4,557
1967-68	4,956	4,893	5,030	5,040	4,755	5,532
1968-69	6,355	6,011	6,851	6,217	5,860	6,907
1969-70						
1970-71						

Source: Table 16, p. 2037, JAMA, November 25, 1968, 206, 9.

$4,800 for operating expenditures (Table 4-1) and $300 for annualized capital expenditures (Table 4-11) per house officer per year. Thus, it would appear from these calculations that for house officer programs the clinical costs far exceed other costs.[40] While the hospitals and not the medical schools incur these costs, they may be legitimate educational costs which should be allocated to the educational program. Note that the $9,300 reflects not only direct costs such as incurred through teaching services provided by hospital staff, but also indirect costs such as from duplicate lab tests.

Teaching Hospital Capital Costs

An additional cost category overlooked in all previous medical school cost studies is the additional capital costs (over and above the already substantial cost on nonteaching hospitals) required to provide the clinical facilities in which to carry out teaching programs for medical undergraduates, interns and residents. In 1966 the U.S. Public Health Services estimated that the cost of hospital buildings and fixed equipment was over $28,500 per bed in general hospitals.[41] At the same time university owned teaching

[40]Note that interns and residents "contribute" patient care services as part of their training. The value of these services is not reflected in these figures.

[41]Representative Construction Costs of Hill-Burton Hospitals and Related Health Facilities, July-December 1966, Washington, D.C.: USPHS (1967), p. iv. as reported in Rosenburgh, C.F., "Contracting Considerations," Costs of Health Care Facilities, Report on a Conference convened by the National Academy of Engineering, December 5 and 6, 1967, Washington, D.C.: National Academy of Sciences, 1968.

hospitals were requiring approximately $60,000 per bed.[42] Presumably the additional money was required for additional equipment, facilities and space related specifically to the teaching programs.

Assuming this and assuming further that teaching hospital facilities have an effective life of 20 years we see that each teaching bed carries with it approximately $1500 ($30,000 ÷ 20) of teaching related cost per year. Since students using the teaching hospital require (on the average) approximately 3.5 beds (Figure 4-1) we estimate that each student requires approximately $5,250 in teaching hospital capital on an annualized basis.

How representative this estimate is of the capital costs attributable to teaching programs at teaching hospitals not owned by universities is not known since capital cost data for hospitals are particularly hard to find. In fact, we are sufficiently uncertain about the magnitude of this cost item to omit it from our summary tables later in this chapter. Suffice it to say that this is an important cost category that needs further investigation.

Cost Incidence Patterns

Table 4-17 presents cost incidence data for fifty university owned teaching hospitals. Since hospital accounting procedures do not

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[42] Table 7a, p. 998, Smythe, "Developing Medical Schools," *op. cit.*

TABLE 4-17

SOURCES OF SUPPORT FOR UNIVERSITY

OWNED OR OPERATED HOSPITALS FOR FISCAL 1970

SOURCE	30 Hospitals Awarded A State Appropriation		20 Hospitals Not Awarded State Appropriation		50 Hospital Total	
	$ Millions	% of Total	$ Millions	% of Total	$ Millions	% of Total
Federal Government						
Medicare	$ 64.2	12.2%	$ 70.9	19.9%	$135.1	15.3%
Other Appropriation	--	--	10.2	2.9	10.2	1.2
State Government						
Medicaid	36.9	7.0	41.1	11.5	78.0	8.9
State Appropriation	137.3	26.1	--	--	137.3	15.6
Additional Welfare	21.3	4.1	11.3	3.2	32.6	3.7
Local						
Blue Cross	64.7	12.3	95.6	26.8	160.3	18.2
Other Insurance	90.8	17.3	64.5	18.1	155.3	17.6
Self-Pay	39.1	7.4	29.2	8.2	68.3	7.8
Professional Fees	6.2	1.2	3.0	0.8	9.2	1.0
County Government	7.3	1.4	5.2	1.5	12.5	1.4
City Government	7.8	1.5	1.2	0.3	9.0	1.0
Other	49.8	9.5	24.3	6.8	74.1	8.4
TOTAL	$525.3	100 %	$356.5	100 %	$881.8	100 %

Source: "University Owned or Operated Teaching Hospitals: State Appropriations and Income Analysis," Datagram, JME, June 1971.

generally identify the specific sources of revenue for teaching activities, we must make some assumptions in order to use these cost incidence patterns in our analysis. Specifically, we will assume that the funding patterns for teaching activites are the same as for teaching hospital activities as a whole.

TOTAL DIRECT COSTS

Perhaps the best way to summarize the material covered in this chapter is to combine the operating, capital and clinical cost estimates into estimates of the total direct costs per student year for the three major educational programs. Table 4-18 presents these aggregate program cost estimates. To emphasize the fact that these figures are estimates we have included estimates of the standard errors of the costs as well.

The figures indicate that the undergraduate program is the least expense on the annual basis, costing roughly one half as much as interns, residents, or basic science students. The standard errors indicate that one can expect considerable variation in both the total cost and the categorical costs from school to school. Despite this, we have no reservations about recommending these figures as reasonable estimates of the total program costs for these three major medical school programs for use in aggregate national studies. They are based on the best available data and analytical techniques.

TABLE 4-18

ESTIMATED TOTAL DIRECT COST PER STUDENT PER YEAR (AND STANDARD ERRORS) FOR MAJOR MEDICAL SCHOOL STUDENT PROGRAMS (1969-70 BASIS)[a]

Program	Estimated Annual Direct Cost			
	Operating[b]	Capital[c]	Clinical[d]	Total[e]
Medical Undergraduate	$4,500 (±1,740)	$ 100 (±220)	--	$ 4,600 (±1,800)
Intern, Resident & Clinical Fellow	$7,600 (±1,880)	$ 400 (±310)	$6,700 (±1,900)	$14,700 (±2,700)
Basic Science Student	$5,800 (±4,570	$2,700 (± 520)	--	$ 8,500 (±4,600)

[a]The figures in this table do not reflect the value, if any, of services provided by students in the course of their education.

[b]1.61 times estimated program costs and standard errors for 1964/65 from Table 3 of Wing and Blumberg, op. cit. The factor 1.61 reflects a 10 percent increase in costs each year from 1964/65 to 1969/70.

[c]1.10 times estimated capital costs for 1968/69 from Table 4-11. The factor 1.10 reflects a 10 percent increase in costs from 1968/69 to 1969/70. Only medical school capital is included.

[d]2.59 times $2,575. The $2,575 figure is an estimate of the 1959/60 house officer costs obtained by averaging the costs reported in the studies by Pratt and Hill op. cit. and Voigt op. cit. The factor 2.59 reflects a 10 percent annual increase in costs from 1959/60 to 1969/70. Salaries and stipends of house officers are not included in these figures, nor are teaching hospital costs. (See section on Teaching Hospital Capital Costs for a discussion of this item.) Data for medical undergraduates and basic science students are not available.

[e]Standard errors are computed on the assumption that operating, capital and clinical costs are statistically independent.

Total Cost of Educating a Physician

Though tangential to the thrust of this study, it is of some interest to use these estimates to derive an estimate of the total cost of educating a physician:

TABLE 4-19

ESTIMATED TOTAL DIRECT COST OF EDUCATION FOR A NEW PHYSICIAN[a]

(1969-70 basis)

Education Level	Annual Cost	×	No. Years	=	Total Cost
Medical Undergraduates	$ 4,600		4		$18,400
Internship	$14,700		1		$14,700
Residency	$14,700		3		$44,100
Total			8		$77,200

[a]The figures in this table do not reflect the value, of any, of services provided by students in the course of their education, nor do they include teaching hospital capital costs or the value of services provided by voluntary faculty.

This procedure underestimates the total cost to the extent that inflation may drive up the annual costs. Some sort of adjustment or scaling would be advisable for anyone trying to estimate (say) the cost of a particular 10 or 20 year medical school expansion plan.

Cost Incidence Patterns

Having combined operating, capital and clinical costs into single program cost estimates, it is interesting to determine the extent to which major supporters of medical education contribute to each program. Table 4-20 summarizes cost incidence data presented earlier (in Tables 4-3, 4-4, 4-13 and 4-17), rounding the percentages off to the nearest 5 percent. These percentages have been applied to the annual cost figures from Table 4-18 to obtain the estimates of support levels from major sources presented in Table 4-21. For simplicity we have presented only the point estimates in this table.

TABLE 4-20

ESTIMATED COST INCIDENCE PATTERNS FOR MAJOR COST CATEGORIES AND MAJOR FUND SOURCES FOR U.S. MEDICAL SCHOOLS,[a] 1969-70 BASIS

Source	Percentage of Direct Support		
	Operating[b]	Capital[c]	Clinical[d]
Federal Government	30%	45%	15%
State Government	25%	45%	35%
Local Community	0%	0%	40%
Student	15%	0%	0%
Other	30%	10%	10%

[a]Includes only direct funding; services not paid for are not accounted for in this table.

[b]Estimated from Table 4-3 and 4-4.

[c]Estimated from Table 4-13 assuming university funds are 50 percent from Federal Government and 50 percent from State Government.

[d]Estimated from Table 4-17.

TABLE 4-21

ESTIMATED COST INCIDENCE PATTERNS FOR THE

THREE MAJOR MEDICAL SCHOOL EDUCATIONAL PROGRAMS[a]

1969-70 BASIS

Source	Program		
	Medical Undergraduate	Interns and Residents[b]	Basic Science Student
Federal Government	$1,400	$3,800	$3,000
State Government	1,200	4,800	2,700
Local Community	0	2,700	0
Student	700	0	900
Other	1,400	3,400	2,000
Total	$4,600	$14,700	$8,500

[a]Includes only direct funding; services not paid for are not accounted for in this table. Detail may not sum to totals due to rounding.

[b]Since Interns and Residents do not pay any fees, we have allocated the 15 percent student item equally to the Federal Government, State Government, and Other.

CHAPTER 5

BENEFITS FROM MEDICAL EDUCATION

We have intimated above that the estimation of benefits from medical education is considerably more difficult than the estimation of the costs. This is because no one really knows what good health is, what it is worth, or even what a physician does. This discussion will by no means resolve these questions but hopefully, we can clarify some of the issues and point the way to further research and data collection.

It is convenient to aggregate the benefits of medical education into two general classes: benefits from the outputs (practicing physicians in particular) and benefits from the process itself. We will refer to these as long-term and short-term benefits, respectively. Unfortunately, we must partially abandon our program emphasis when considering the benefits of the outputs since practicing physicians must participate in at least two of the education programs (as we have defined them).

The dollar estimates of the benefits provided in several of the tables in this chapter are very tentative. In presenting them we risk drawing attention away from more substantive issues and problems, but for the sake of completeness we have provided our best quantitative estimates. In cases where we have been unwilling to trust our judgment, we have merely omitted dollar values. We hope that readers will accept them for what they are, tentative first estimates to stimulate discussion.

LONG TERM BENEFITS

In this section of the paper we will consider two major sources of benefits: physicians and research. More specifically, we would like to try to derive estimates of the benefits that arise from physicians and their services and from research at its derivatives.

Although the assumption that physician services are worth exactly what is paid for them (i.e., that there is a perfect market place) does have some intuitive appeal, the imperfections in the medical market place are too well known to drop the discussion at this point. Restricted entry into the medical profession, consumer ignorance and externalities are among the major imperfections.

The question then is how best to estimate the economic benefits from physician services. Noting that economic benefits are indirect (i.e., they do not accrue directly from physicians services), it seems appropriate to adopt a two-stage procedure: first, estimate the relation of physicians to health, and then estimate the value of the change in health, if any, that results from physician services. The analysis that follows is based entirely on previous studies, all of which have had different though related purposes. Variations in definitions, choice of variables, etc. make clean, tight analysis impossible, but there is enough common ground to support some general conclusions.

Health Indicators

Before we can discuss the relation of physicians to health, we must establish a definition for health. This is a problem that has been receiving increasing attention in the last decade, and although definitive results are not yet available, there have been some significant contributions.

One of the major problems has been pointed out by Gerald Besson: Different groups in the health care system have decidely different perspectives on the definition problem and there seems to be little likelihood for a reconciliation in the near future. After looking in turn at the views of patients, health professionals and social scientists, he proposes a broader concept of health based on the interaction of individual and environment.

> Optimal health . . . may be accomplished by decreasing the threat of the environment or by raising the capability of the host to defend himself . . . . In the framework of this definition the profession changes its emphasis. We deal more with people and less with patients. We deal more with health and less with disease. We deal more with human condition and less with formal and fixed pathology. We deal more with sociocultural hazards than with biological ones. We deal more with a continuance of care, less with the episode of sickness.[1]

This, like the World Health Organization definition of health[2], is

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[1] Besson, G., "The Health-Illness Spectrum," American Journal of Public Health, Vol. 57, No. 11, November 1967, p. 1904.

[2] WHO has referred to good health as "a state of physical, mental, and social well-being." See Measurement of Levels of Health, report of a study group, WHO, Geneva, 1957.

not particularly useful at present. We must consider some simpler alternatives if we are to proceed further.

The one most often used is age-specific or age-adjusted mortality rate (deaths per capita) and despite its shortcomings it is likely to be used for some time to come. In the U. S. there is generally too little variation in these death rates across states or counties for it to be a useful measure of not-health. Morbidity (i.e., sickness or disease incidence) thus becomes a more relevant measure. But morbidity is related to mortality (i.e., a reduction in deaths from one specific cause generally results in an increase in deaths from other causes and/or an increase in morbidity from the specific cause). Sanders has even suggested that increased prevalence of various chronic diseases may be an indication of better medical care.[3]

Despite the problems, progress has been made in constructing a definition of health that can be used in analytical and comparative studies. Research on the problem has been reviewed recently by Fanshel and Bush.[4] They conclude that none of the indices proposed by their predecessors is adequate and propose one of their own, based on categorizing all members of the population into one

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[3] Sanders, B. S., "Measuring Community Health Levels," American Journal of Public Health, Vol. 54, No. 7, July 1964, esp. page 1068.

[4] Fanshel, S. and J. W. Bush, "A Health-Status Index and Its Application to Health-Services Outcomes," Operations Research, 1970, pp. 1021-1066.

and only one of a set of health "states" which are points on a continuum of a single dimensional scale of function/dysfunction. Although this concept has a certain appeal, we are not convinced that their index would be any easier to implement than those that they have criticized. Ranking degrees of illness is not going to be an easy task.[5] Packer has suggested a very similar scheme and his discussion makes it somewhat easier to see how such an index might be used in an applied research study.[6] It is clear, however, that it will be some time before such a health status index proves its worth. Considerable analysis will be required to estimate the values or costs associated with being in or moving between different states on the health illness spectrum.[7]

Lacking a comprehensive health status index we must fall back on the available alternatives. Since original research in this area is beyond the scope of this study, we will have to be content with the measures that have been selected by the researchers.

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[5]There is also the problem of combining the indices for all the individuals in the population into a single aggregate health status index. In addition, there is the operational problem of maintaining updated files of the health status of all individuals.

[6]Packer, A. H., "Applying Cost-Effectiveness Concepts to the Community Health System" Operations Research, Vol. 16, 1968, pp. 227-253.

[7]The work of Dorothy Rice should be a valuable guide in this regard. Her studies (Estimating the Cost of Illness, Health Economics Series, No. 6, USPHS, May 1966, and "Measurement and Application of Illness Costs," Public Health Reports, Vol. 84, No. 2, February 1969.) attempt to assess the total impact of illness. It should be possible to adopt some of her notions to obtain some estimates of the impact of changes in average health status.

whose analyses we are reviewing. These are usually some form of age-specific or age-adjusted mortality index.

Relation of Physicians to Health

There have been several studies of the determinants of health in the last few years. Each of them has included physicians as one of the explanatory variables in the model or analysis constructed to study the question.

Irma Adelman in a cross section regression model across 34 countries found that M.D. per population had a significant negative effect on mortality for most age groups.[8] Her study, based on United Nations data, was not designed specifically to investigate the impact of health services but the results are of interest nevertheless. It is doubtful that her findings can be applied to the U. S.

Joseph Newhouse, in his study of resource allocation in medical care[9], found that "Practitioners per Population" was not a significant explanatory variable in a logarithmic cross section model using U. S. data in which mortality was the dependent variable. In a similar study, Mary L. Larmore also found that physicians

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[8]Adelman, I., "An Econometric Analysis of Population Growth," American Economic Review, June 1963, Vol. 53, No. 3, pp. 326-328.

[9]Newhouse, J. P., Toward a Rational Allocation of Resources in Medical Care, (unpublished Ph.D. dissertation) Cambridge: Harvard University, August 1968. See Table 7-8 on page 244.

per population was not a significant explanatory variable for mortality rates.[10] Her conclusions were based on a county by county cross section model for the U. S.

Using a rather different approach Victor Fuchs came to a similar conclusion. Using a composite mortality index, he defined a set of 12 "healthiest" states and a set of 12 "least healthy" states. Then he performed Mann-Whitney "sum of ranks" tests to determine the extent to which potential explanatory variables were related to the "healthy-unhealthy" dichotomy. Although education, paramedical personnel per capita, and percentage of physicians in group practice were statistically significant (at the 0.05 level) the number of physicians per capita showed no relation at all to health levels.[11] Fuchs also ran some regression models across 48 states which indicated that states with higher physician/population ratios appear to have higher mortality. He found it "difficult to believe that the presence of hospital beds or of physicians contributes to higher mortality, although that is one possible interpretation of the regression results. An alternative interpretation . . . is that physicians tend to locate in states where there is a disproportionate amount of sick people, many of whom will die prematurely despite the presence of physicians."[12]

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[10] Larmore, M. L., An Inquiry into an Econometric Production Function for Health in the United States, (unpublished Ph.D. dissertation), Evanston, Illinois: Northwestern University, August 1967.

[11] Fuchs, V. R., "Some Economic Aspects of Mortality in the U. S.," (mimeo), New York: NBER, July 1965. See page 25.

[12] Ibid., p. 27

In another study conducted by the NBER, Auster, Leveson and Sarachek ran cross section regression models which indicated that states with more health expenditures per capita tend to have lower age-sex adjusted (white) death rates.[13] A second model which disaggregated medical services into four components (drug expenditures, physicians, paramedical plus capital, all per capita, and group practice) showed, as had Fuch's analysis, that states with higher physicians per capita appear to have higher mortality, though with a two-stage least squares procedure the coefficient was statistically insignificant. One of their tentative conclusions was that expenditures on education may lead to larger reductions in mortality than expenditures on medical care.

A study of determinants of life expectancy in Western Hemisphere countries by Charles Stewart led to a similar conclusion.[14] He found that literacy (a proxy for information), and potable water (a proxy for prevention) were significantly related to life expectancy, while treatment variables were not. Data from the United States also suggested a low marginal productivity of medical treatment in terms of life expectancy.

Whether or not these results would stand if better indices of health were available is not clear. These are the best data that are currently

[13]Auster, R., I. Leveson and D. Sarachek, "The Production of Health, An Exploratory Study," Journal of Human Resources, Vol. 4, No. 4, Fall 1969, pp. 411.536.

[14]Stewart, C. T., "Allocation of Resources to Health," Journal of Human Resources, Vol. 6, No. 1, Winter 1971, pp. 103-22.

available, however, and they definitely suggest that more physicians is not the best solution. As Fuchs has said:

> While the total contribution of physicians to health is undoubtedly very large, it is possible that their marginal contribution is small. It may be that additional dollars spent for paramedical personnel, or education, or public health (broadly conceived), would do more to reduce mortality and infant mortality than would the expenditure of an equivalent sum to increase the supply of physicians.[15]

Contrasting the findings of Adelman and the analysts of the U. S. situation, we conclude that physicians have a significant marginal impact on mortality only in developing and underdeveloped countries. Of course better health indices might yield rather different results.

Value of Improved Health

If it were true, as suggested in the aforementioned studies, that additional physicians have no significant impact on health, there would be no real need to continue this discussion of benefits from physicians. However, since these studies are by no means conclusive, we would like to mention briefly some studies that are relevant to the task of estimating the value of improved health.

Selma Mushkin was one of the first to review the subject of the value of health.[16] She discussed three approaches to the problem of evaluating investments in health that had been developed by previous analysts:

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[15]Fuchs, op. cit., p. 29.

[16]Mushkin, S., "Health as an Investment," Journal of Political Economy, Vol. 70, No. 5, October 1962, p. 129-157.

<u>Developmental cost approach</u>: "Compares the lost investment in the rearing of a child who dies before making his full contribution to production with the investment required to enable him to make that contribution."[17] The problem with this approach is that the effect of the share of the investment that is for health is hard to disentangle from the share for other aspects of child rearing.

<u>Capitalized earnings approach</u>: Is widely used today. It evaluates programs on the basis of discounted cost and earnings streams.

<u>Contributions to national income approach</u>: Compares public expense with public gain. Economic gains are typically taken to be aggregate salaries. For evaluating specific government programs tax revenues are sometimes a better choice.

A recent study by Leveson, Ullman and Wassall provides an interesting example of the latter approach.[18] Considering such factors as dropouts, armed forces rejectees and psychological problems, they estimate the total annual loss to society through dropping out of school for health reasons. Using statistics on earnings for

[17] <u>Ibid</u>., p. 149

[18] Leveson, I., D. Ullman and G. Wassall, "Effects of Health on Education and Productivity," <u>Inquiry</u>, Vol. 6, No. 4, 1970, pp. 3-11.

for different levels of education they arrived at a dollar estimate of the loss to be between $3 and $4 billion. They also suggest that the total stock of human capital may be as much as $50 billion less than it otherwise would be because of this dropping out. An earlier study by Dorothy Rice[19] followed similar lines in estimating the total impact of disease on national output. The problem with both of them is that they do not relate their findings to programs that might have an impact on the national economy. That, of course, is the next step. We need studies to estimate the specific effects on health status of particular health related programs.

Relation of Medical Schools to Geographic Location of Physicians

Regardless of the studies cited above, current medical technology restricts a doctor's influence to the locality in which he practices. This suggests another avenue for research, related more to local and regional than to national concerns: What factors govern the

[19] Rice, D. P., Estimating the Cost of Illness, Health Economics Series No. 6, Washington, D.C., U. S. Department HEW, PHS Pub. No. 947-6, May 1966. For additional discussion see: Weisbrod, B. A., Economics of Public Health, Philadelphia: University of Pennsylvania Press, 1961, 127 pp.; Roberts, N. J., "The Values and Limitations of Periodic Health Examinations," Journal of Chronic Disease, Vol. 9, No. 2, February 1959, pp. 95-116; Rice, D. P. and B. S. Cooper, "The Economic Value of Human Life," American Journal of Public Health, Vol. 57, No. 11, November 1967, pp. 1954-66; Roberston, Robert L., "Issues in Measuring the Economic Effects of Personal Health Services," Medical Care, Vol. 5, No. 6, November-December 1967, pp. 362-368.

location decisions of physicians? Rather than attempt to deal with the subject in its entirety, we will focus on the relation of medical schools to physician location. Readers interested in more detail should refer to the overview of the problem by Philip Held.[20]

Frank Sloan in his doctoral dissertation concluded that "Medical students [educated in the state] appear to have virtually zero impact on physician location."[21] He went on to state that his "evidence indicates rather clearly that states' efforts to attract physicians by increasing the number of residents attending medical school are in vain. Interstate mobility is much too great for these policies to succeed."[22]

Two of a series of unpublished state-by-state scatter plots by Mark Blumberg (Figures 5-1 and 5-2) support Sloan's conclusions. One indicates that the number of state residents entering medical school is uncorrelated with the number of M.D. graduates that ultimately practice medicine in a state. The other shows an inverse

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[20] Held, P. J., "Distribution and Migration of Physicians in the U.S.," (mimeo), Thesis Prospectus, Berkeley: Department of Economics, U. C., December 6, 1970. More accessible but less complete is the review by Fein and Weber in Financing Medical Education, New York: McGraw-Hill Book Co., 1971, esp. pp. 153-162. Blumberg has also discussed the subject in, "Medicine and Related Occupations," (mimeo), Berkeley: Office of Health Planning, University of California, December 1969, esp. pp. 92-104.

[21] Sloan, F. A., "Economic Models of Physician Supply," (unpublished Ph.D. dissertation), Cambridge: Harvard University, August 1968, p. 357.

[22] *Ibid.*, p. 378.

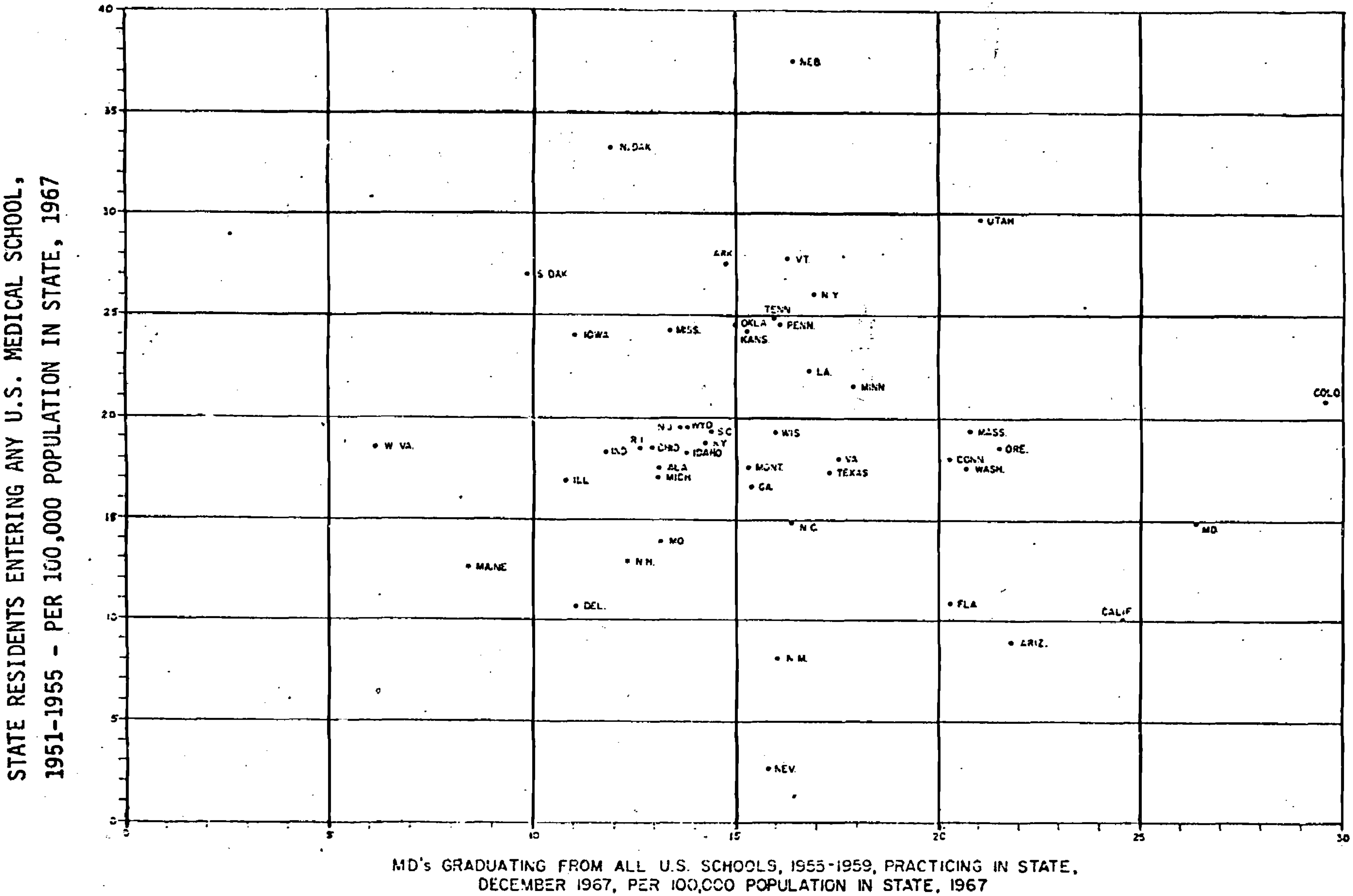

FIGURE 5-1

PRACTICING MD'S RELATIVE TO STATE RESIDENTS ENTERING MEDICAL SCHOOL IN THE 50 STATES

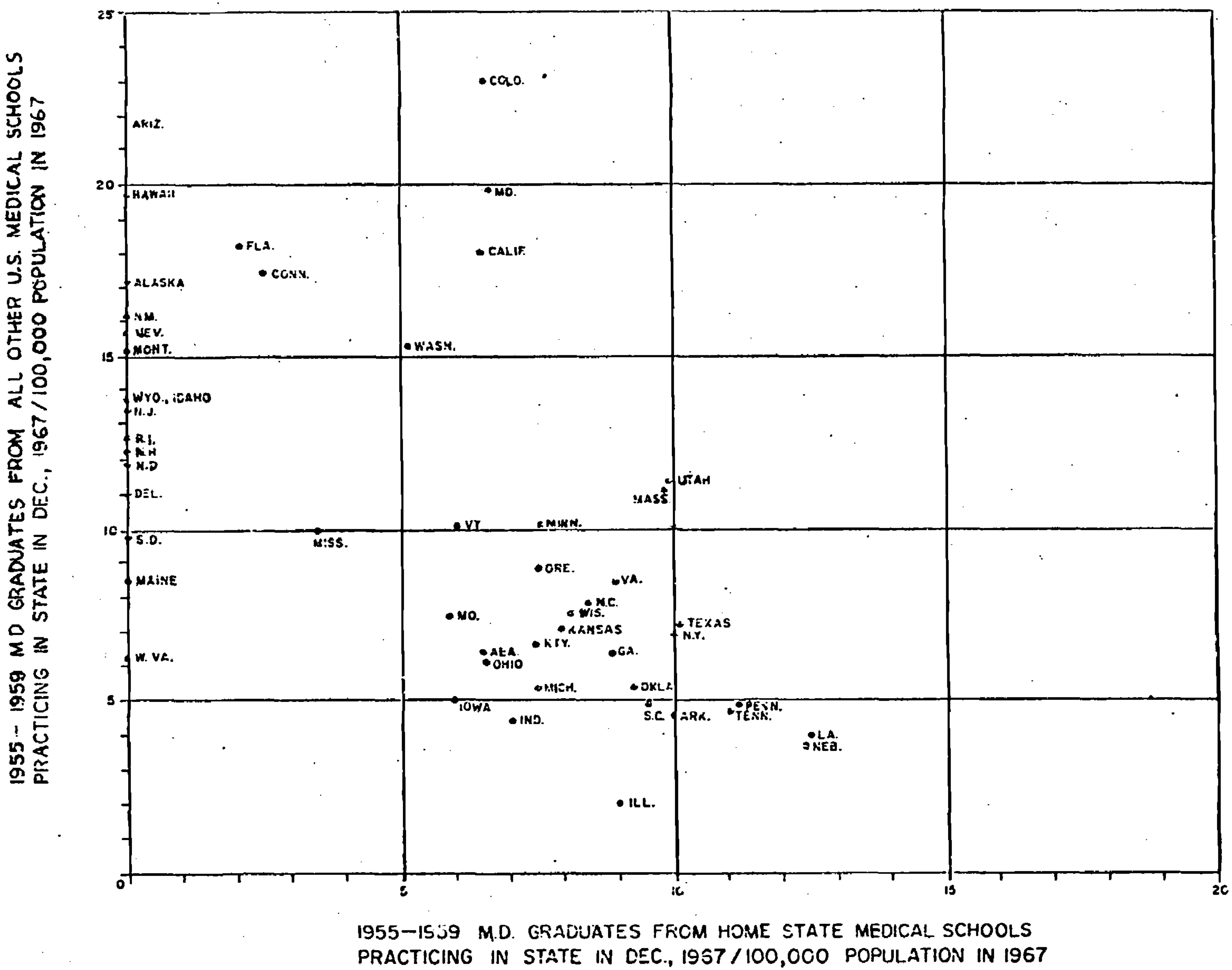

FIGURE 5-2

PRACTICING MD'S FROM HOME STATE MEDICAL SCHOOLS RELATIVE TO PRACTICING MD'S FROM ALL OTHER MEDICAL SCHOOLS IN THE 50 STATES relation between the number of instate medical school graduates practicing in a state and the number of out-of-state medical school graduates practicing in a state.[23]

Fein and Weber constructed some empirical models to estimate the relationship between the number of graduates from schools in a state and the ability of the state to attract physicians. They concluded "that a 10 percent increase in the number of resident graduates would only lead to a 3.2 percent increase in the number of graduates locating in the state."[24] We do not find the model on which this conclusion is based very satisfying. Although the variables are certainly reasonable, the use of undeflated variables, both dependent and independent, limits the usefulness of the model.[25]

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[23]These figures were prepared by Blumberg while he was Director of Health Planning of the University of California. Two other scatterplots in this series show a positive relation between physicians practicing in a state and both internships filled and residencies filled in the state. Two others show a lack of relation between physicians practicing in a state and both home state entrants to home state medical schools and all graduates from medical schools in the state. One final one shows a marked positive relation between M.D.'s migrating into a state and white males migrating into a state.

[24]Fein and Weber, op. cit., p. 160.

[25]Since large states tend to have more medical school graduates, larger changes in population and larger everything else than do small states, it should not be surprising that "the absolute change in state population 1954 to 1967" is an important explanatory variable in a regression model in which the "total 1950-59 U. S. medical school graduates located in the state in 1967" is the dependent variable. We suspect that the particular formulation chosen by Fein and Weber (Equation D-3, page 256) may have led to results that mask a more accurate indication of the determinants of physician location. We feel that it would be more appropriate to use variables such as "percentage (as opposed to absolute) change in population" in this type of empirical model.

While none of these studies relate directly to the benefits of medical education they are clearly relevant to the discussion. We will refer to them in our analysis in the next chapter.

Research

The estimation of the benefits from research is a particularly elusive problem. The nature of research is such that the outcomes are not known in advance. And thus it is generally agreed that estimating the benefits that can be expected from a particular research project or set of research projects is an intractable problem. *Ex post facto* studies can be done and used to evaluate the performance of those who allocated research support funds but basically there seems little hope for much more. Even *ex post facto* evaluation is not always possible; carry over and spill over effects, effects on human capital, etc., are particularly hard to disentangle and quantify.

We have no suggestions to offer at this point. It is clear that biomedical research has led to vast improvements in our knowledge of human health, etc. We doubt that we have yet recouped the investments that have been made. But our understanding grows constantly and tnis may lead to a breakthrough that will more than justify the investment.

Individual Rates of Return on Medical Education

Rates of return to medical education have been analyzed and estimated by a number of researchers over the past thirty years.[26] They are generally regarded to be the best single indicator of economic return on educational investment. Our purpose here is not to review the research that has been done in detail but simply to refer to it as an indicator that medical education represents a good economic investment for a student selecting a career. The value of the rate of return approach is that it accounts for both the expected costs of the education and the expected subsequent earnings. Equally important, it reflects (via the discount rate) the timing of the expense and income items and also the fact that alternative investments are possible.

The results of the various studies indicate that except during the 1930's physicians have obtained a rate of return on their educational investment greater than that from nearly all other professional education and greater than the market rate of interest. Attempts to

[26]See, for example: Friedman, M. and S. Kuznets, Income from Independent Professional Practice, New York: National Bureau of Economic Research, 1945; Hansen, W. L., "Shortages and Investment in Health Manpower," The Economics of Health and Medical Care, Ann Arbor, Michigan, 1964; Sloan, F. A., Economic Models of Physician Supply, (unpublished Ph.D. dissertation), Cambridge: Harvard, 1968; Fein, R. and G. I. Weber, Financing Medical Education, New York: Mc Graw-Hill, 1971, especially Appendix C; Rada, E. L., E. B. Hymson and C. Chiang, A New Longitudinal Human Capital Rate-of-Return Model with Physicians as Subjects, (mimeo), Los Angeles: School of Public Health, University of California, n.d., 133 pp.

relate changes in rate of return to changes in the relative supply of physicians have been inconclusive, but the relatively high return for physicians is one indication that a shortage of them exists. The estimates of the actual rate of return vary from about 13 percent to as much as 30 percent depending on the choice of opportunity costs and the set of expense items as well as the discount rate. Ronald Loshin in a comparative study of rate of return analyses in higher education has noted that analysts are far from uniform in their definitions and sometimes fail to document their procedures adequately.[27] This precludes the comparison of the results of different analysts, but the general conclusion that medical education offers larger economic returns than most other professions seems to be justified.

SHORT TERM BENEFITS

As additional groundwork for the analysis in the next chapter, we will discuss short term benefits in terms of the groups that receive them. Essentially, these fall into two groups: a) benefits related to services provided by students and staff of medical schools not reflected in the standard accounts, and b) benefits related to outside groups and businesses served by the school and its community of students and staff.

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[27] Loshin, R. S., "Private and Social Costs in Higher Education," (DRAFT), Berkeley: University of California, 1969.

To the Medical School

Although it may be unconventional we would like to begin our discussion of benefits with the medical school itself. Several of the education programs bring important and often overlooked side benefits which should be considered carefully in any program analysis.

Consider for example interns and residents. A time study at the Yale-New Haven Hospital Medical Center has provided some preliminary estimates of the work patterns of the house staff.[28] The data are presented in Table 5-1. Despite the small sample, these data are the best that are currently available and we will try to apply them to our analysis.

By applying these activity rates to an estimate of the total value of their services, $15,000 per year for lack of a better figure, we can obtain estimates of value of their specific services. The results are summarized in Table 5-4.

In a simmilar manner we can estimate the value of services provided by the basic science students. In this case data are even more scarce but some figures have been compiled by the National Science Foundation. We have summarized them in Table 5-2. Applying the average activity rates to an estimate of the total value of their

[28]Carroll, A. J., "Program Cost Estimating in a Teaching Hospital, A Pilot Study," (edited by T. J. Campbell and M. H. Littlemeyer), Evanston, Illinois: AAMC, 1968.

TABLE 5-1

RELATIVE WORK LOADS OF INTERNS, RESIDENTS, AND CLINICAL FELLOWS IN THE YALE-NEW HAVEN HOSPITAL MEDICAL CENTER

Activity	Interns	Residents and Clinical Fellows	Interns, Residents and Clinical Fellows
Teaching	4.3%	5.1%	4.8%
Research	1.9%	4.6%	3.8%
Patient Care	80.4%	71.4%	74.1%
Self Improvement	12.3%	17.5%	15.0%
Unallocated	1.1%	1.3%	1.4%

Source; Carroll, A. J., "Program Cost Estimating in a Teaching Hospital, A Pilot Study," (edited by T. J. Campbell and M. H. Littlemeyer), Evanston, Illinois: AAMC, 1968 (Table on pp. 148-9).

TABLE 5-2

ESTIMATED EMPLOYMENT OF BASIC SCIENCE STUDENTS IN TEACHING AND RESEARCH AT U.S. MEDICAL SCHOOLS, 1969

Total No. of Basic Science Students[a], 1968/69		9092
FTE Graduate Students[b] Receiving Stipends for Part-Time Work as Scientists		
Teaching	1,101	
Research and Development	1,303	
Other	389	
Total	2,793	2793
Estimated Percentage of Time Spent Working		
Teaching (1101/9092)	12.1%	
Research (1303/9092)	14.3%	
Other (389/9092)	4.2%	
Total (2793/9092)	30.6%	30.6%

[a] Masters, Doctoral and Postdoctoral Students as listed in Table 4, Page 1560, JAMA, November 24, 1969.

[b] Definition uncertain. Data from Table C-4, Page 111 of Resources for Scientific Activities at Universities and Colleges 1969. National Science Foundation (NSF 70-16), Washington, D.C.: USGPO, 1970.

services, $15,000 per year for lack of a better figure, we arrive at the estimates of their services in Table 5-4.

In both of the above cases we imply only that the medical schools obtain valuable services from these students. We make no assumption about the value of the services to society or any other group or agency. Such additional benefits, if any, will be covered in the discussion of the appropriate beneficiary.

Next we would like to consider sponsored research. Probably the most important tangible benefit from sponsored research that accrues to the medical school is the salary support provided to the faculty members. Table 5-3 summarizes this salary support for recent years; it is very clear that a great many faculty members, many of whom are probably in "small" subspecialties, receive at least partial compensation in this manner. To the extent that research is a legitimate program for a medical school we should specifically account for this benefit. We propose the following approach:

> First estimate the full time equivalent (FTE) number of faculty positions supported by sponsored research. Then apply a reasonable average salary for these positions to obtain an estimate of the total benefit. And finally divide this by the total of sponsored research to get an estimate of the benefit per dollar of sponsored research.
>
> Assuming that the percent of salary paid is equal to percent of effort obtained, we estimate the effective number

TABLE 5-3

SALARY SUPPORT PROVIDED TO FULL-TIME MEDICAL SCHOOL FACULTY BY FEDERAL RESEARCH AND/OR TRAINING GRANTS[a]

	Percentage of Support			
Year	100%	50%-99%	1%-49%	0%
1960/61	1,984[b]		1,565	7,562
1961/62	2,188[b]		1,764	8,088
1962/63	1,792	1,169	2,449	8,171
1963/64	2,203	1,392	2,734	8,137
1964/65	2,695	1,673	3,148	7,998
1965/66	2,929	1,830	3,723	8,667
1966/67	3,311	2,111	4,054	9,820
1967/68	3,656	2,500	4,602	11,405
1968/69	3,466	2,871	4,710	11,967

[a]Table entries are numbers of faculty

[b]Up to 1961/62, records were kept for 50 percent or more

Source: Appendix I, Table 5 from "Medical Education in the U. S., 1968-69," JAMA, Vol. 210, No. 8, November 24, 1969 and comparable tables from other JAMA education issues.

TABLE 5-4

ECONOMIC BENEFITS TO A MEDICAL SCHOOL

FROM ITS MAJOR PROGRAMS

Program	Benefit	Estimated Value
Medical Undergraduate	----	----
Intern, Resident & Clinical Fellow	- Teaching Services - Research Services	\$750/year \$600/year
Basic Science Student	- Teaching Services - Research Services	\$1800/year \$2100/year
Sponsored Research	- Prestige - Faculty Support	? \$0.05/dollar
Joint or General	- Services of Voluntary Faculty	0

of faculty positions supported by sponsored research to be roughly:

$$3500 + 0.6 \times 2500 + 0.25 \times 4600 = 6100$$

At $20,000 per year this represents approximately $120 million in salaries. Since the total of all sponsored research at U. S. medical schools is approximately $700 million, we obtain an estimate of the benefit from research of about 15 cents for every dollar spent.

This result should not be applied indiscriminately. It is realistic only to the extent that the research that is currently being sponsored is an integral part of the medical school operation (i.e., to the extent that the school would have to maintain it if the sponsor withdrew his support). We can see little justification for considering salary savings from sponsored research as a tangible benefit if the research is the major reason for the salaries in the first place. It certainly is beneficial, but we feel that it should be reported as an intangible benefit (e.g., some sort of program enrichment). In that sense sponsored research at medical schools is "merely" contract work complementary to the main programs at the schools.

Given the severe financial difficulties that face most medical schools it is hard to imagine them assuming financial responsibility for a significant amount of research that is now funded extramurally. For this reason we tend to favor the position that the benefits are intangible. We do admit that some tangible benefits do accrue, however, and for the sake of discussion we will arbitrarily assume that 5 cents of tangible benefits accrue for every dollar of sponsored research.

We can think of no short term benefits attributable specifically to medical undergraduates. One might argue that gifts and bequests of alumni should be considered as such but we do not think they should. These donations, in our opinion, are essentially belated payments to the schools for value received and as such do not qualify as benefits, despite their importance at some private schools.

Before turning to benefits to the community, we would like to briefly consider voluntary faculty at medical schools. Wing and Blumberg have pointed out that the value of services contributed to medical schools has not been included in any published analysis of medical school costs.[29] We would like to consider here whether these volunteered services should be included in our list of benefits. There is no doubt that the value of the services of voluntary faculty may be substantial[30], but unless cost estimates are increased correspondingly, we cannot count these services as an offsetting benefit. Since current practice is to omit these amounts from cost accounts, we will treat the services as valueless. If

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[29] Wing and Blumberg, op. cit.

[30] We have already noted (in Chapter 4) that at UCSF the voluntary faculty contributed services valued at about $2500 per medical undergraduate in 1968/69.

cost accounts were to properly reflect these services, one still might want to exclude some part or all of these services from the benefit tabulation. To the extent that particular services would have to be purchased on the open market, they should be included as benefits. However, services that would not be purchased if not provided by a volunteer should not be counted as benefits.

To the Local Community

Of the individual medical school programs, both house staff and continuing education programs offer significant benefits to the local community. Interns, residents and clinical fellows provide substantial amounts of patient care services in their hospital based programs, and continuing education programs keep practicing physicians in touch with recent developments in medical science and technology.

We do not know h to estimate the value of the latter, but we can provide a rough estimate of the value of house officer services provided to the local community. Using the activity analysis from Table 5-1, and an estimate of the total annual value of house officer services of $15,000 per year, we obtain an estimate of benefits to the community of $12,000 per year per house officer. This figure is roughly what the community would have to pay to get nonstudent personnel to provide the same basic services. Presumably a fully licensed physician would be the only suitable substitute under current medical regulations, and while a certain amount of the duplication and review built into house staff training programs could probably be avoided, thus saving some money, the larger salary required would undoubtedly raise the substitution cost to something near our $12,000 estimate. This assumes that house officers do provide valuable services that would have to be provided by others if they were not on duty in the hospital.

Newhouse, though unable to conclude that physicians have a significant impact on health, did present a cross section model of 22 SMSA's that indicated the presence of a medical school was related to lower mortality rates among the 15-44 year age group. He suggested that this "may stem from better staffing of emergency rooms [by house staff] if more medical schools are present."[31] This would lead to lower mortality from accidents, which are an important cause of death in this age group. In a related cross section model across 44 states, he found that the medical school/ population variable did not enter the model. "The insignificance of the medical school variable across states implies that the benefits associated with medical schools accrue only to the area immediately surrounding them."[32]

Whether or not this is the case cannot be proved from this evidence alone. We have already discussed the apparent lack of influence of

[31] Newhouse, J. P., Toward a Rational Allocation of Resources in Medical Care, (unpublished Ph.D. dissertation), Cambridge: Harvard University, August 1968, p. 250.

[32] Ibid., p. 375.

physicians on currently available health indices. In light of scarcity of facts, we will be content here to assume that the $12,000 savings from using "substitute" labor represents the only benefit to the community attributable to house officers.

The other medical school programs do not appear to carry with them significant benefits to the community. However, there are other sources of potential benefit which should be considered in this discussion, sources which relate not to a specific program but rather to the entire medical school program.

The community impact of education has only recently begun to receive the attention of educational analysts and economists. Only a few studies on this subject have been published and none of them relate to the impact of medical schools on the community.[33] A preliminary report on the subject by Donald Winkler[34] seems to indicate that tools and concepts are available for such studies and that some work has been done. One of the most important of these analyses was an input-output study of the impact of the

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[33]The University of California has sponsored at least one study of the local impact of its medical schools, but the reports have not been released pending further evaluation.

[34]Winkler, D. R., "The Regional Impact of an Institution of Higher Education," (DRAFT), Berkeley: University of California, September 1970. This paper is a preliminary report of work still in progress by Winkler and Professor F. E. Balderston of the Business School at the University of California, Berkeley.

space program on the city of Boulder, Colorado.[35] One sector of the input-output model in this study included the University of Colorado. Unfortunately (but understandably), the activities of the university (i.e., undergraduate teaching, graduate teaching, research and public service) were not disaggregated, but the overall impact has been estimated. Winkler, in his analysis of this research, concluded that "the university sector has larger local and state income effects per dollar of delivery to final demand than do the manufacturing sectors."[36] Thus, spending at the University of Colorado led to more additional consumer spending than did comparable spending in the manufacturing sectors in Boulder. Similar analysis of employment indicates smaller differences in effects on employment across industrial sectors. Service and manual labor sectors tend to have higher, and business trades (e.g., finance, rentals) tend to have lower, multiplier effects. The University of Colorado exhibited, if anything, a slightly lower than average employment multiplier.[37]

Less sophisticated, but interesting nevertheless, are studies of

[35] Miernyk, W. H., et. al., Impact of the Space Program on a Local Economy, Morgantown: West Virginia University Library, 1967, 167 pp.

[36] Winkler, op. cit.

[37] See Table V-9, page 121 of Miernyk, et. al., op. cit.

community impact sponsored by the University of California.[38] It is not possible from these studies to estimate the multiplier effects of the university operations, but the relation of campus to the local community is made much clearer.

One thing that comes from studies like those mentioned above is that cost and benefit estimates must be tied to specific cases. Differences in tax structures, land use patterns, community interests, etc., would lead to different estimates in each community. Another thing that should be remembered is that these analyses are really useful only in comparative studies. It may be interesting to find out that an existing medical school in city X brings Y dollars a year in benefits to the city, but such information is only useful in the context of eliminating or changing the functions and services of the school. Since the local government is typically faced with the problems that arise out of campus-community relations, it might be worth considering the analysis of community impact with respect to local government agencies (i.e., the net local impact rather than the gross local impact). This will likely lead to a rather different picture. The question becomes, not what are the income and employment multipliers, but what are the net effects on tax revenues and community "psyche". With this in mind, we mention

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[38] See, for example, Fink, I. S., The Community Impact of the University of California, Berkeley, and Santa Cruz Campuses, Berkeley: Office of the Vice President, Physical Planning & Construction, April 1967, 30 pp. The major flaw of this study is that it concentrates on the gross, rather than the net, impact of the campuses on their respective communities.

the two major sources of local revenue: property taxes and sales taxes.

Property Taxes: The property tax benefits (or costs) that arise from a medical school depend on the alternative uses of the land that are contemplated and also the impact on surrounding land areas. Recently established medical schools have been built on more than 100 acres of land. Since the land is typically removed from the tax rolls, community planners need to multiply the acreage by the net income per acre to the community that could be derived by the best alternative use. They should also try to assess changes in land and property values in adjacent land parcels in order to round out the picture.

Sales Taxes: This probably presents more difficult problems to the community planner since he must try to estimate actual and probable spending patterns in the local and surrounding communities that can be related to a medical school operation and the alternative land uses. Note that actual spending patterns may be very interesting but they are only relevant to this discussion to the extent that they generate (directly or indirectly) revenue for the community. Where local sales taxes exist (or where local communities share the state levy) such patterns are clearly quite relevant.[39]

The task of estimating the local benefits (or costs) may not be as difficult as it first seems. Considering the control that local communities have over land use patterns through zoning, etc., one could presumably obtain reasonably accurate estimates of spending patterns of students, faculty, and institutions based on their own estimates or the few published studies that are available. Whether the results would be worth the effort is not clear, but some sort of estimate should be obtainable.

There are other potential sources of local impact that should be considered, for example, to the local construction business and to local job markets. However, there is little point in more than mentioning them since they depend even more than taxes on local conditions.

To the State

Outside of the possible prestige that may accrue to a state from

[39] As an example of the type of impact studies that can be done, we would like to mention an unpublished analysis by Ira Fink of the University of California of the gross impact of visitors to the UCSF campus on the city of San Francisco. The study indicates the following visitor patterns:

Students	11.6 visitor days per year
Faculty	23.4 visitor days per year

A related study indicated that each visitor to Moffit Hospital spent about $5.25 in San Francisco. To assess the community benefit (or cost), these expenditures must be carried back to the final revenue to the city, not an easy task in most instances.

TABLE 5-5

ECONOMIC BENEFITS TO A LOCALITY FROM

MAJOR PROGRAMS OF A LOCAL MEDICAL SCHOOL

Program	Benefit	Estimated Value
Medical Undergraduate	------	------
Interns & Residents	- Patient Care Services	$12,000/year
Basic Science Students	------	------
Sponsored Research	------	------
Continuing Education	- Higher Quality Patient Care	?
Joint or General	- Sales taxes	?
	- Property taxes	?
	- Prestige	?
	- Attractiveness To Physician	?

having a medical school, most short term benefits accrue to the particular community in which the school is located and thus have been touched on in our previous remarks. As then, we must defer any attempt to quantify tax benefits (or costs) since this would require rather precise information on the impact of the school on the community.

Often cited as a benefit by proponents of new public medical school facilities is the increased opportunities for medical careers that are provided to young residents in the state. This argument is very appealing on the surface, but on closer examination, there seems to be very little evidence to support it. The contention is that when more public medical school facilities are built then more state residents will attend medical school and benefit from the education.[40] But what does this gain the taxpayers of the state? It is a gain for the students, but not for them. In fact, they would probably pay more for this "opportunity" because of differential fee structures that favor state residents that are

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[40]A study of medical school applicants by Mark Blumberg and Paul Wing ("Medical School Applicants and Acceptances: A Cross Section Study," (mimeo), Berkeley: Office of Health Planning, University of California, March 1970, 29 pp.) did show that providing additional public medical school openings in a state does result in both more applicants and more acceptances among state residents. The study also indicated that the impact of more openings on the percentage of applicants accepted is much less pronounced. Thus, if a state were interested in increasing the acceptance <u>rate</u> for its residents, it would probably have to invest much more heavily in medical schools than it might initially anticipate.

currently used in most states.

The next step in the logic carries us to the argument that, even if it did cost the taxpayers a little more for the education, the state would end up with more doctors and better medical care and better health, and that this is the ultimate benefit that is of interest. In our discussion of long term benefits above we have discussed this is some detail. We do not believe that there is sufficient evidence available to support this claim, intuitive as it may be. Our interpretation of the limited empirical research that has been done on this general problem leads us to assign zero value to the "opportunity benefit".

One might argue that state residents have the right to insist that their own children be given the opportunity to compete for the wealth, prestige and satisfaction that accompanies a medical career. We completely agree. But we would not consider it a benefit to the state. The whole thing looks to us like a very special raffle in which all the taxpayers in the state buy tickets and only a handful have an opportunity to win.

To the Nation

We can think of no short term benefits to the nation that have not already been considered for at least one other recipient group.

All of the potential benefits appear to be of the long term variety and whether or not these actually accrue is open to question.

CHAPTER 6

AN ANALYSIS OF COSTS AND BENEFITS

Now comes the task of applying the information on costs and benefits from the previous chapters to some relevant questions and decisions. It was our original intention to perform a cost-benefit analysis, but, as suggested in Chapter 3 and verified in Chapter 5, there are too many unknowns to justify this. Instead we will consider a few important general questions about medical education, applying the results of our analysis where appropriate. It will be very clear that there is insufficient factual evidence to answer some of these questions definitively, but we think that we can shed some light on the subject without becoming too speculative.

Should More Physicians Be Educated in the U.S.?

If one assumes that better health is the primary objective of medical education, and accepts mortality indices as adequate measures of health levels, he might conclude that additional medical schools would be a poor investment. The evidence presented in Chapter 5 indicates that, at least at the margin, having more physicians does not result in lower mortality; and this seems to eliminate additional medical education as an effective means to that end. However, recognizing that individuals and other private interests may feel that more doctors are warranted for other reasons, we would not arbitrarily discourage investment in more medical schools. But as a means to obtain better health (measured by mortality) in the U.S., it does seem to be a poor choice.

How can this conclusion be reconciled with the widely held belief that there exists a shortage of physicians, a belief that is supported by a substantial amount of economic research?[1] There are three explanations that seem plausible to us:

1. Mortality is an inadequate measure of health. Physician services do have a significant impact on health, but it is not reflected in mortality rates.
2. People do not know what they will receive when purchasing physician services. Since the public is essentially convinced that the services are valuable (whether or not they really are), they continue to purchase them.[2]

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[1]Martin Feldstein, for example, recently concluded that "aggregate pricing and use of physician services can be understood best by assuming that permanent excess demand prevails. Sheltered by this excess demand, physicians have discretionary power to vary both their prices and the quantity of services which they supply." See Feldstein, M. S., "The Rising Price of Physicians' Services," Review of Economics and Statistics, Vol. 52, No. 2, May 1970, pp. 121-133.

[2]We suspect that medical science has only recently begun to reach a stage at which physicians can have a significant impact on mortality. Medicine has survived as a profession only because people have believed that a causal relation existed between his treatment and the patient's normal recovery. We doubt that such a causal relationship has ever been very strong, even today. This certainly does not mean that physician services are worthless. Faith is an important part of the healing arts. And there is no doubt that medicine can ease pain and speed recovery.

3. People purchase physician services primarily in times of stress, pain or fear. This leads them to ignore market indicators and other knowledge they may be aware of.

We have no doubts that all three explanations are at least partially true, but does this help us to answer the question posed above? We think not. In fact, we think it makes the situation a bit more vexing. Since no one really knows what physicians really accomplish or how to measure it, it is clear that decisions of this kind are based almost entirely on subjective values and speculation.

On another, perhaps more practical level, one can argue that it is not important whether or not there is a significant relation between more physicians and better health. As long as the public demand for their services exceeds the supply there exists an opportunity for public benefit via increasing the number of physicians. The general market mechanism whereby increased supply tends to drive prices down is the one of interest. The question that remains to be answered is whether the cost of educating additional doctors can be offset by the effect of lower charges. And this in turn raises questions regarding the effect on physician fees of additional physicians. Neither of these questions has been adequately explored and the prospects of seeing these general economic hypotheses tested seem quite remote at this time.

Of course if there were a significant relation between physicians and health, one could attempt to estimate the economic impact of additional physicians using the general logic outlined in the previous chapter. He would then compare the stream of public benefits (over the life of the individual physicians) with the stream of public costs (over the period of his education) using a cost-benefit approach. This would give us some sort of economic measure of the appropriateness of additional medical schools which could then be played off against subjective evaluations of the desirability of greater access to physicians in order to answer the question.

Should a State Invest in More Medical Schools?

Even if medical education were found to be a reasonable national investment, it might be an unreasonable one for a state. Since the evidence from Chapter 5 indicates that medical school production is only slightly, if at all, related to the physician supply in a state, we conclude that additional medical education programs would be a poor economic investment for a state. To the extent that more doctors are needed, states should not invest their own resources but move towards full cost tuition and/or rely on the federal government for support. Notice that we conclude this independently of whether doctors are related to health and other factors such as the costs of education although these other factors do not alter our conclusion.

Who Should Pay for Medical Education?

In the discussion above we have focused on questions about educating more physicians and suggested that public investments for this purpose are not well justified by empirical evidence. Despite this, we recognize that physicians do, on the average, provide significant services and they are not likely to pass from the scene. Thus we would like to consider who should pay for the major programs at medical schools. We will take the general position that those who benefit from a program ought to pay for it.

If physicians did not contribute to average health levels in this country, the high economic rates of return on their educational investment would lead us to conclude that the physician himself (or the prospective physician, if you prefer) should bear the major portion of the direct expense of his education. The average taxpayer should not be burdened with the expense for the professional education of an individual who thereby obtains income, prestige, etc., that is substantially higher than the average if he does not make a significant contribution to society. However, while we have suggested that the marginal contributions of additional physicians may be small, we have not argued (nor are we willing to) that physicians do not make a significant contribution on the average. This complicates any analysis of financing since presumably the public should be willing to share the cost of medical education to the extent that it receives benefits. This leads us back to the problem of estimating public benefits which has yet to be resolved by research analysts.

To the extent that average benefits to society from physicians are positive, we feel that society should contribute to the cost of medical education. In keeping with the evidence regarding the distribution of physicians across states we feel that any such societal contributions should be made by the federal government rather than the state governments. This "would place a relatively larger burden on higher-income groups. . . [and since] students with parents in these income groups receive the greater part of direct benefits from public subsidization of medical education, a shift of the tax burden to these income groups can hardly be faulted on the grounds of inequity."[3] Of course, if some state wishes to provide additional support for special programs for whatever reason, they should be free to do so. But they should be aware that the relation between any investment they make and the supply of physicians is tenuous at best.

In light of the almost complete lack of data on public benefits from physician services and considering the relatively high rate of return on medical education, we are of the opinion that the recent position of the Carnegie Commission was taken prematurely. They recommended "a relatively low uniform national tuition policy," with a substantial supplement by the federal government.[4] This may well amount to giving money to the doctors who already are quite

[3]Fein & Weber, op. cit., p. 195.

[4]Higher Education and the Nation's Health, Policies for Medical and Dental Education, A special report of the Carnegie Commision on Higher Education, New York: McGraw-Hill, October 1970, p. 63. Fein and Weber have pointed out that "increased general subsidization of the four years at medical school or increased stipends during internship and residency will increase the private rate of return to the future physician unless it is associated with an expansion of the number of physicians large enough to reduce future relative incomes of the medical profession." See Fein and Weber, op. cit. p. 195.

well off by nearly any objective criteria one might wish to use.

Basically, we would like to charge as much tuition as the student will bear. What this amount or portion should be has yet to be determined. Analysis along the lines of that suggested by Fred Balderston related to the ability of medical students to pay tuition seems particularly appropriate.[5] He points out that depending on the discount rate, shifting the burden of paying for education to the student via loans or tuition, or even shortening the repayment period, may leave the student unable to recoup his investment. We would hesitate to recommend any tuition or loan plan that, under reasonable assumptions about future discount rates, left students with no net payoff on line educational investment, particularly in a field of study such as medicine that apparently does have some average payoff to society. This might discourage potential students from entering this field, thus restricting further the supply of physicians. But in the case of medical education we would be surprised if it turned out that somewhat higher tuitions eliminated the net return on investment.

The recommendation of the Carnegie Commission that federal grants be awarded to medical schools for students from low-income families

[5]Balderston, F. E., "The Repayment Period for Loan-Financed College Education," Paper P-15, Berkeley: Ford Foundation Research Program in University Administration, Vice President-Planning & Analysis, University of California, January 1970.

also concerns us. They cite "psychological barriers to incurring indebtedness on the part of students from low-income families" as the primary reason.[6] In our opinion, this has little to do with health care or medical education. It may help to more equitably distribute opportunities to practice medicine, but we doubt it would affect health care in any way. The "barrier to incurring indebtedness", if it exists, is one that should be broken down through an education program of some kind but not a medical education aid program. The Commission's recommendation deals with the symptom, not the cause.

We do concur with the Commission's recommendation than an Educational Opportunity Bank be established to dispense loans to students desiring them.[7] This allows the student to assume the burden of his own education should he be so inclined, and we would never oppose that.

The discussion so far has not touched on the most obvious case for public support for medical education, namely, local support for house officer programs. This does seem to make some economic sense, assuming, of course, a local committment to the sorts of medical care that can be provided by house officers. On the cost side house officers require about $2,700 per capita per year of local

[6] Carnegie Commission, op. cit., p. 64.

[7] Ibid., p. 65.

money (Table 4-21). And since they provide about $12,000 worth of services to local communities (Table 5-5), it would certainly appear that house officer programs deserve serious consideration by local planners.

Other Questions

The questions raised above are purposely very broad and general. We have tried to qualify our answers to reflect the general lack of understanding and agreement about objectives and values of medical education and health care. In fact, we feel that additional analysis of this type would not be sufficiently productive to warrant proceeding further with it at this time. Too much depends on opinion and judgment, and not enough on facts and figures.

Many questions remain unanswered. We only hope that the data that we have assembled and derived will be of use to analysts who must answer them, and that we have provided a stimulus to further research.

CHAPTER 7

SUMMARY, CONCLUSIONS AND SUGGESTED RESEARCH

> This is a critical time for medical schools and for the system of medical education. Increasing demands are being placed upon the schools. . . There is pressure for expansion. . . for the development of education and programs for new types of health personnel . . . [and for] new patterns of patient care. Medical education is being asked to assume a leadership role in changing the system of medical care delivery and organization. . . Never, perhaps, has there been as much need - and as much opportunity - for a rational examination of the total activities of medical schools.
>
> To a significant extent, of course, the increasing pressures placed upon medical schools are directly derived from an overall questioning of the existing health care system. There is doubt that this system - if it can be characterized as a system - is serving the nation effectively and efficiently. . . That medical education is not the only part of the system being asked to reexamine itself is clear. That, as a major part of the system, it cannot adopt a limited perspective and consider itself to be uninvolved and exempt from examination is, however, also clear.[1]

We concur and we hope this paper contributes to a broadening of the perspective of medical education planning.

By extending our investigation of medical education beyond the medical school, we have been forced to consider a series of fundamental questions that arise about the relation of medical education to society. Our study has pointed out a number of interesting, even baffling, paradoxes,[2] nearly all of which tend to undermine traditional and

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[1]Fein, R. and G. I. Weber, Financing Medical Education, New York: McGraw Hill, 1971, pp. 220-1.

[2]Nathan Glazer in "Paradoxes in Health Care," The Public Interest, No. 22, Winter 1971, pp. 62-77 has observed many of the same anomalies.

widely held justifications for medical education. The evidence, though neither complete nor conclusive, suggests that a rather thorough reexamination of medical education is in order. Perhaps medical doctors are not closely related to average health levels, and if so, it is time to adjust our thinking and spending accordingly.

Of course, medical education is not going to disappear, and this leaves the question of who should pay for it. Nearly all of the recent studies of this question have concluded that more federal funding is appropriate. If a positive relation between physicians and health is confirmed, this may be the best alternative; but if it is not, a shift of the financial burden to the student and the physician seems more appropriate. Since no recent study supports the position that more doctors would improve average health levels in the U. S., it seems premature to increase student subsidies at this point.

Our analyses of these and related questions in Chapters 5 and 6 are certain to be controversial. We have chosen to attack these issues directly despite this because we feel the questions are extremely important. We hope that by raising them we can stimulate further research in several fields which will lead to better understanding of health, health care delivery and the roles of physicians. The need for further research is clear and so too, we think, is its potential impact.

Perhaps less controversial is our analysis of the costs of medical education in Chapter 4. The empirical analysis of capital costs, while far from perfect, does provide what seem to be reasonable ballpark cost estimates where other approaches are useless. We suspect that this regression approach may be useful in other similar situations in higher education. We again caution readers about the use of these cost estimates. In empirical studies and even in cost accounting studies, cost estimates are useful only over the range of program mixes at the set of schools on which the analysis is based. Thus, it would be inappropriate to presume that medical undergraduates could be educated in the absence of the other major programs for the $4,600 per year indicated in Table 4-18.

We have suggested in Chapter 3 that neither systems analysis nor economic cost-benefit analysis is <u>by itself</u> an adequate tool for a thorough planning effort in medical education. There is simply insufficient knowledge of both internal relationships at medical schools and external effects of medical education programs to support a planning effort using only one of these techniques. This has led us to a sort of hybrid analysis that draws on either approach as the need arises, and we would like to suggest that this "synthetic methodology" is quite appropriate for this type of study. Perhaps on a theoretical level these sorts of distinctions are not terribly important, but in practice they are very important. Substantial barriers, primarily semantic, have been constructed between operations research and economics over the past two decades. In the study of a system as complex as medical education, such barriers can only impede progress. Although this particular study has drawn more heavily from the tools and concepts of economics than of operations research, we hope that we have made clear the need for a synthesis.

Our analysis is, we feel, a reasonably sound prototype for the analysis of education systems in general. Were more information available so that we could conclusively answer some of the questions we have raised, we could proceed with analyses of other more operational problems. However, important basic questions about such things as the need for and impact of educational programs should be addressed early in the game if there is to be any hope of efficient allocation of resources and talents.

Suggestions for Future Research

More research is needed on all aspects of medical education. We have mentioned many of the specific needs in our discussion above. A few of the major topics warrant repeating:

1. It is time to stop talking about better health indices and start gathering the data for one or more of the promising alternatives. This will pave the way for, among other things, further analysis of the impact of physicians on health levels.

2. There is need for systematic study of the determinants of health. How important is nutrition? family structure? exercize? ethnic background? Statistical comparisons of individuals or groups would probably be appropriate.[3]
3. There is a need for research on the delivery of health care. Studies should be designed so that they suggest efficient staffing levels, which can in turn be translated into production quotas for health education programs.
4. Who pays for medical education? How much does it cost? Ours is just a crude first step toward the answer to these important questions.
5. What goes on in the process of medical education?
   a) What are typical activity patterns of faculty and students?
   b) What is the role of research in a medical school? What resources does it require?
   c) How much teaching is done t hospitals? How much does it cost?
   d) What is an efficient size for a medical school? a department? What is an efficient mix of programs?

[3]A study proposed by the Board on Medicine of the National Academy of Sciences has considerable merit. See "Contrasts in Health Status, A Comparative Inquiry into the Health Needs, Barriers, and Resources of Selected Population Groups," Washington, D.C., December 1969.

A Final Consideration

Perhaps as important as additional research on health and health care would be the dissemination of information that is currently available. As far as we can determine, the public is ignorant of most of the material presented in this paper. Without such knowledge we cannot see how decision and policy makers can adequately serve the public interest.

APPENDIX A

SOURCES OF DATA ON MEDICAL SCHOOL FINANCIAL SUPPORT FOUND IN TABLES 4-3 AND 4-4

TABLE A-1

SOURCES OF SUPPORT FOR U.S. FOUR YEAR MEDICAL SCHOOLS IN 1964-65

Sources of Support	Data Sources	
	Sponsored Programs	"Regular" Programs
Federal Government	104 + 212	101 + 116
State Government	-	228 + 266 - 255
State & Local Government	105 + S(213)	227
Private		
Industry	106 + 110 + S(213)	-
Foundations	107 + 112 + S(213)	215 + 216
Vol. Health Agencies	108 + 111 + S(213)	-
Other or Not Itemized	109 + 113 + S(213)	102 + 217 + 218 + 219
Medical School		
Endowment	114	214
Reserves	-	260 - 251 - 254
Students	-	1/2 · 211
University	-	226 + 261 + 262 + 264 + 265 - 252 - 253
Miscellaneous	115	221 + 222 + 223 + 224 + 2261

Note 1: Numbers represent line numbers on the Annual Medical School Questionnaire of the Association of American Medical Colleges.

Note 2: "S(213)" means "share of line 213." Share for a particular category is equal to the fraction of total from all five sharing categories represented by the particular category. For example, for Industry the share is 106 + 110/105 + 106 + 107 + 108 + 109 + 110 + 111 + 112 + 113.

Note 3: Definitions are not entirely adequate. "'Sponsored programs' are medical college activities that are fostered and supported by outside agencies or organizations under special contracts, restricted grants, and restricted gifts... 'Sponsored programs' often are tailored more to the resources and interests of the fostering agencies than to the basic needs of the college." Thus the key distinction is the restricted use of the monies.

Note 4: The allocation of lines to "Sponsored" and "Regular" categories does not conform to the AAMC practice. The major discrepancy is that overhead for sponsored programs is allocated to sponsored programs, whereas the AAMC allocates these overhead items to regular programs.

TABLE A-2

CONTENTS OF SELECTED LINES OF ANNUAL MEDICAL SCHOOL QUESTIONNAIRE OF THE AAMC

Line	Contents
101	Expenditures for Federal contracts or grants "restricted" for teaching and training.
102	Expenditures for non-government contracts or grants "restricted" for teaching and training.
104	Expenditures for Federal research contracts or grants "restricted" for research.
105	Expenditures for state, city or county contracts or grants "restricted" for research.
	Expenditures for non-government contracts or grants "restricted" for research.
106	From industry
107	From foundations (Rockefeller, Ford. etc.)
108	From voluntary health agencies (American Cancer Society, etc.)
109	From other outside sources
	Expenditures for non-government gifts "restricted" for research
110	From industry
111	From voluntary health agencies
112	From foundations
113	From individuals
114	Expenditures from endowment income "restricted" for research.
115	Expenditures from other funds "restricted" for research.
116	Agency for International Development grants and contracts for foreign teaching programs.

TABLE A-2 (continued)

Line	Contents
211	Tuition and fees.
212	Overhead on Federal grants and contracts.
213	Overhead on non-Federal grants and contracts.
214	"Unrestricted" endowment income.
	"Unrestricted" gifts and grants to medical college
215	From National Fund for Medical Education
216	From AMA Education and Research Foundation
217	From Alumni
218	From others
219	From others
220	Income from college services.
	Medical College expenses paid or the estimated value of services provided by
221	All medical service funds
222	Teaching or research institutes
223	Teaching hospitals or clinics
224	Other organizations
226	Other units of college or university
2261	Gifts, grants, and special funds from outside sources restricted for library, or other phases of regular medical college operation.
227	State, city, or county grants in aid or subsidies paid to the medical school.
228	Grants in aid or subsidies paid through interstate compacts, such as WICHE or SREB.

TABLE A-2 (continued)

Line	Contents
251	Surplus held as a reserve for future operations.
252	Surplus paid to university as reimbursement for services.
253	Surplus held as part of General University Funds.
254	Surplus deducted from medical college appropriations for the following year.
255	Surplus refunded to the State treasury.
260	Surplus from prior year's operations
	Funds from General University Funds exclusive of state appropriations
261	Portion from unrestricted endowments
262	Portion from unrestricted gifts and grants
264	Portion from profits on auxiliary enterprises
265	Portion from miscellaneous income and reserves.
266	State appropriations

More detail is available from the "Annual Medical School Questionanire, Part 1," Evanston: AAMC.

APPENDIX B

REFERENCE DATA ON CAPITAL EXPENDITURES AT U.S. MEDICAL SCHOOLS

TABLE B-1

MEDICAL SCHOOL CONSTRUCTION COMPLETED[a]

IN RECENT YEARS IN $ MILLIONS

Year	Teaching	Research	Medical Service	Other	Total
1960-61	$ 8.2	$25.4	$ 9.4	$ 4.8	$47.9
1961-62	4.1	15.1	18.6	4.6	42.4
1962-63	8.1	28.0	5.3	6.6	48.0
1963-64	12.1	58.7	10.1	9.0	89.9
1964-65	21.2	42.8	27.0	12.3	103.3
1965-66	12.1	15.6	7.3	2.7	37.9
1966-67	59.9	56.2	32.1	13.9	162.2
1967-68	49.8	50.9	22.0	9.3	132.0
1968-69	65.2	52.1	19.9	15.7	153.0
1969-70	$92.2	$69.1	$26.4	$21.0	$208.7

[a]As opposed to initiated or planned or proposed.

Source: Figure 1, page 1996 of JAMA, 206, No. 9, November 26, 1968 and comparable figures in other JAMA education issues.

TABLE B-2

U.S. MEDICAL SCHOOL CAPITAL PROJECTS COMPLETED, INITIATED, AND PLANNED FOR RECENT YEARS ($ MILLIONS)

	Completed		Initiated		Planned	
	Constr.	Equipment	Constr.	Equipment	Constr.	Equipment
1962-63						
Teaching	8.1	0.6	32.0	4.7	26.5	2.6
Research	28.0	2.2	69.4	7.3	63.2	6.9
Medical Services	5.2	0.7	15.7	4.1	32.4	3.8
Other	6.6	0.7	4.3	0.4	8.4	1.5
Total:	48.0	4.3	121.4	16.5	130.4	14.8
(New Plans)					(88.7)	(11.1)
1963-64						
Teaching	12.1	0.9	14.6	2.4	50.2	5.0
Research	58.7	8.4	32.6	4.6	54.9	5.3
Medical Services	10.1	1.5	21.6	2.8	52.7	4.6
Other	8.9	0.4	7.8	0.9	11.4	0.6
Total:	89.9	11.2	76.6	10.8	169.2	15.4
(New Plans)					(109.9)	(9.5)
1964-65						
Teaching	21.2	3.4	37.3	4.9	126.4	15.8
Research	42.9	7.7	40.4	4.0	104.4	16.6
Medical Services	26.9	4.3	27.7	2.8	57.2	3.8
Other	12.3	1.1	2.5	0.2	14.3	1.5
Total:	103.3	16.4	107.8	11.9	302.3	37.7
(New Plans)					(222.4)	(32.6)

TABLE B-2 (continued)

	Completed		Initiated		Planned	
	Constr.	Equipment	Constr.	Equipment	Constr.	Equipment
1965-66						
Teaching	12.1	1.7	56.2	6.4	124.6	29.4
Research	15.7	2.0	62.7	6.0	79.3	15.8
Medical Services	7.4	0.3	24.3	3.7	29.0	3.5
Other	2.7	0.3	10.3	0.5	17.7	1.4
Total:	37.9	4.3	154.5	16.6	250.7	50.1
(New Plans)					(121.5)	(34.0)
1966-67						
Teaching	60.0	8.6	53.6	7.6	161.2	18.3
Research	56.2	6.2	66.5	8.0	84.4	9.9
Medical Services	32.1	3.4	14.3	2.2	23.6	2.2
Other	14.0	1.6	15.1	1.0	20.0	2.3
Total:	162.2	19.7	149.5	18.8	289.2	32.8
(New Plans)					(150.4)	(15.4)
1967-68						
Teaching	44.5	5.4	133.8	15.2	136.5	16.0
Research	46.6	4.3	56.6	6.3	81.3	7.7
Medical Services	19.9	2.2	24.2	2.5	25.1	3.2
Other	8.8	0.5	16.6	2.4	19.2	1.3
Total:	119.7	12.4	231.3	26.4	262.1	28.3
(New Plans)					(171.7)	(16.7)

TABLE B-2 (continued)

	Completed		Initiated		Planned	
	Constr.	Equipment	Constr.	Equipment	Constr.	Equipment
1968-69						
Teaching	56.7	8.6	125.6	11.4	148.2	19.9
Research	46.9	5.1	80.4	6.9	74.1	7.1
Medical Services	17.7	2.3	95.0	7.7	61.1	15.2
Other	13.9	1.8	13.6	0.8	12.6	1.6
Total:	135.2	17.8	314.6	26.8	196.0	43.7
(New Plans)					(251.9)	(41.3)
1969-70						
Teaching	80.5	11.7	137.6	10.2	235.9	26.8
Research	62.1	7.0	66.2	4.9	99.4	9.8
Medical Services	24.1	2.3	85.2	3.7	51.4	9.0
Other	19.1	1.9	51.0	1.7	41.1	1.3
Total:	185.7	23.0	340.0	20.5	427.9	46.9
(New Plans)					(345.7)	(37.6)

Source: Medical Education Issues of JAMA for 1963 to 1970.

TABLE B-3

SOURCES OF FUNDS FOR CONSTRUCTION OR IMPROVEMENT OF MEDICAL SCHOOL BUILDINGS INITIATED OR COMPLETED[a] IN RECENT YEARS[b]

Year	Federal	State	University	Private	Other	Total
1966-67	$ 93.1	$106.7	$ 57.4	$54.2	$19.3	$330.5
	(28.2%)	(32.1%)	(17.4%)	(16.5%)	(5.8%)	(100.0%)
1967-68	$152.4	$ 72.3	$ 60.7	$48.0	$16.3	$350.0
	(43.5%)	(20.7%)	(17.4%)	(13.7%)	(4.7%)	(100.0%)
1968-69	$192.5	$143.7	$ 95.2	$34.9	$28.8	$495.1
	(39.0%)	(29.0%)	(19.0%)	(7.1%)	(5.9%)	(100.0%)
1969-70	$181.3	$165.8	$160.3	$30.9	$26.9	$565.2
	(32.0%)	(29.3%)	(28.3%)	(5.6%)	(4.8%)	(100.0%)

[a]Essentially this represents expenditures actually made (as opposed to planned or proposed) in the given years.

[b]In $ millions

Source: Figure 1, page 1996 of JAMA, 206, No. 9, November 25, 1968, and comparable Figures in 1967, 1969 and 1970 JAMA education issues.

APPENDIX C

SOURCES OF DATA USED IN THE ANALYSIS OF MEDICAL SCHOOL FLOORSPACE

Table C-1 indicates how the variables used in the regression model were computed. The V-#'s correspond to the code numbers for the variables presented in Table C-2. The D-#'s in Table C-2 correspond to the data source documents.

The floorspace data were obtained from the Inventory of College and University Physical Facilities assembled by the Office of Education in their Higher Education General Information Survey.[1] We have used only rows 5, 20, and 25 and columns 2, 3, 4, 5, 6, 7, 12, and 13 of the questionnaire (OE-Form 2300-7) which account for nearly all the floorspace at the medical schools other than that in residential and general use (e.g., dining commons) categories. For row 20 (Organized Activity Units) we used only column 13 (Medical Care). The definitions used for the OE survey[2] indicate that this floorspace category includes human hospital-clinic and patient

[1] A summary of this survey is contained in H. L. Dahnke and P. F. Mertins "Inventory of Physical Facilities in Institutions of Higher Education, Fall 1968," Washington, D.C.: National Center for Educational Statistics, U.S. Department of HEW, 1970, 49 pp.

[2] Nicholas A. Osso, ed., "Higher Education Facilities Classification and Inventory Procedures Manual," Washington, D.C.: Higher Education Studies Branch, National Center for Educational Statistics, U.S. Department of HEW, 1968, 102 00.

care facilities, and veterinary hospital-clinic and animal care facilities. Unfortunately, OE-Form 2300-7 provides only the total floorspace devoted to Organized Activity-Medical Care Facilities. We assume that most of this is for medical care.

For row 25 (Organized Research Units) we used only column 2 (Total Square Feet Assignable). Most of this was laboratory space, although at a few schools some Office Space was included in the total. For simplicity we have worked only with the figures in the Total column.

The Total less Medical Care floorspace figures are probably slightly understated for most schools, primarily because schools were instructed to include in an unclassified category (rather than a specific school category) all classroom space shared by more than one school. We have no idea how much of this unclassified space is attributable to medical schools, but the error is probably small. Note that this is a problem only for classroom space; very little space was reported in the unclassified category for other types of floorspace.

We have noted another potential source of floorspace data to which we were unable to gain access. On all facilities grant applications, applicants are required to itemize their existing floorspace and facilities. The Division of Educational and Research Facilities of the Bureau of Health Professional Education and Manpower Training of U.S. Department of HEW maintains files of these applications. These files might be of some value in further empirical study of medical school floorspace.

TABLE C-1

DEFINITIONS OF VARIABLES USED IN THE MODELS

Variable Code	Variable Name	How Computed
1	Total less Medical Care Floorspace	V-1+V-2+V-3+V-4+V -5+V-6+V-9
2	Medical Care Floorspace	V-7+V-8
A	Medical Undergraduates, 1967-68	V-10
B	Interns, Residents, and Clinical Fellows, 1967-68	V-11+V-12+V-13
C	Basic Science Students, 1967-68	V-14+V-15+V-16
D	Full Time Faculty, 1966-67	V-17+V-18
E	Voluntary Faculty, 1966-67	V-19
F	Public Variable (dummy)	V-20
G	Hospital Variable (dummy)	V-21
H	Dental School Variable (dummy)	V-23
I	Average Daily Census, 1966	V-24
J	Annual Outpatient Visits, 1966	V-25

TABLE C-2

RAW DATA AND SOURCES

Code	Variable	Source
V-1	Medical School I & R Classroom Floorspace	row 5, col. 3, [D-4]
V-2	Medical School I & R Laboratory Floorspace	row 5, col. 4, [D-4]
V-3	Medical School I & R Office Floorspace	row 5, col. 5, [D-4]
V-4	Medical School I & R Study Floorspace	row 5, col. 6, [D-4]
V-5	Medical School I & R Special Use Floorspace	row 5, col. 7, [D-4]
V-6	Medical School I & R Supporting Floorspace	row 5, col. 12, [D-4]
V-7	Medical School I & R Medical Care Floorspace	row 5, col. 13, [D-4]
V-8	Medical School Org. Act. Medical Care Floorspace	row 20, col. 13, [D-4]
V-9	Medical School Org. Res. Total Assignable Floorspace	row 25, c-l. 2, [D-4]
V-10	Medical Undergraduates, 1967/68	Table 4, p. 2086,[D-3]
V-11	Interns, 1967/68	Table 4, p. 2086,[D-3]
V-12	Residents, 1967/68	Table 4, p. 2086,[D-3]
V-13	Clinical Fellows, 1967/68	Table 4, p. 2086,[D-3]
V-14	Basic Science Masters Students, 1967/68	Table 4, p. 2086,[D-3]
V-15	Basic Science Doctoral Students, 1967/68	Table 4, p. 2086,[D-3]
V-16	Basic Science Postdoctoral Students, 1967/68	Table 4, p. 2086,[D-3]
V-17	Full-Time Clinical Faculty, 1966/67	Table 1, p. 3, [D-2]
V-18	Full-Time Other Faculty, 1966/67	Table 1, p. 3, [D-2]
V-19	Voluntary Faculty, 1966/67	[D-6]
V-20	Public School	Table 1, p. 1994, [D-3]
V-21	Hospital Owned by the School	[D-5]
V-22	School New or Moved Since WWII	[D-1]
V-23	Dental School on Campus	Medical School Catalogs
V-24	Average Daily Census at Medical School Hospital	List of Approved Internships [D-7]
V-25	Annual Outpatient Visits at Medical School	List of Approved Internships [D-7]

TABLE C-2 (continued)

DATA SOURCES

[D-1] Blumberg, M. S., and Eve Clarke, "Major Locational Factors - U.S. Medical Schools," (mimeo), Berkeley, California: Office of Health Planning, University of California, July 1967.

[D-2] "Full-Time Medical School Faculty, Fiscal Year 1967, Resources for Biomedical Research and Education," Report No. 16, March 1969, Washington, D.C.: National Institutes of Health, U.S. Department of HEW.

[D-3] "Medical Education in the U.S., 1967-68," Journal of American Medical Association, CCVI, No. 9, Nov. 25, 1968, p. 1987-2112.

[D-4] Unpublished data from U.S. Office of Education, OE-Form 2300-7, Washington, D.C.: Office of Education, U.S. Department of HEW.

[D-5] Unpublished list from Council of Teaching Hospitals, Evanston, Illinois: Association of American Medical Colleges, 1969.

[D-6] Unpublished data from AAMC, Evanston, Illinois: Association of American Medical Colleges, 1968.

[D-7] Directory of Approved Internships and Residencies, 1967-68, Chicago, Illinois: Council on Medical Education, American Medical Association, 366 pp.

APPENDIX D

SCHOOLS USED IN THE ANALYSIS OF MEDICAL SCHOOL FLOORSPACE UTILIZATION

Medical College of Alabama*

University of Arkansas School of Medicine*

University of California College of Medicine, Irvine

University of California School of Medicine, Los Angeles*

University of Southern California School of Medicine

Stanford University of Medicine

University of California School of Medicine, San Francisco*

Howard University College of Medicine

University of Miami School of Medicine

University of Florida College of Medicine*

Emory University School of Medicine*

Medical College of Georgia*

Chicago Medical School

Northwestern University Medical School

University of Chicago Pritzker School of Medicine*

University of Illinois College of Medicine*

Indiana University School of Medicine*

University of Iowa College of Medicine*

University of Kentucky College of Medicine*

University of Louisville School of Medicine

Louisiana State University School of Medicine

Boston University School of Medicine

University of Michigan Medical School

Wayne State University School of Medicine

University of Minnesota Medical School*

St. Louis University School of Medicine

Washington University School of Medicine

Creighton University School of Medicine

Albany Medical College of Union University

Columbia University College of Physicians and Surgeons

Cornell University Medical College

Albert Einstein College of Medicine of Yeshiva University

New York Medical College*

New York University of New York College of Medicine, Brooklyn

University of Rochester School of Medicine and Dentistry

State University of New York College of Medicine, Syracuse*

University of North Carolina School of Medicine*

Duke University School of Medicine*

University of Cincinnati College of Medicine

Case Western Reserve University School of Medicine

Ohio State University College of Medicine*

University of Oregon Medical School*

Hahnemann Medical College of Philadelphia

Jefferson Medical College of Philadelphia

Temple University School of Medicine

University of Pittsburgh School of Medicine

Medical College of South Carolina*

University of Tennessee College of Medicine

Baylor University College of Medicine

University of Utah College of Medicine

University of Vermont College of Medicine

Medical College of Virginia

University of Washington School of Medicine*

University of Wisconsin Medical School*

* "Medical Care" sample.

APPENDIX E

NOTES ON MEDICAL SCHOOL CONSTRUCTION COSTS AND USEFUL LIFE OF MEDICAL SCHOOL FACILITIES

Data on construction costs and lifespan of facilities at medical schools are not easy to find. This discussion is meant to summarize the data that is available and also to indicate how useful empirical guidelines might be constructed in the future.

Construction Costs

In a personal communication with the author, Cochrane Browne[43] suggested that construction of new medical schools costs about \$200 per assignable square foot (usable area excluding walls, halls, etc.) as of July 1970. This amount covers the complete construction project including equipment, utilities, landscaping, etc. The cost for buildings alone (exclusive of central utilities, landscaping, equipment, etc.) is about \$100 per assignable square foot (ASF).

Although there have been a few published papers that have reported construction costs for medical schools and other similar facilities, they are not always comparable. Cheves Smythe, in his article on

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[43] Office of the Vice President---Physical Planning and Construction, University of California, Berkeley.

developing medical schools[44], provides estimates of the cost per gross square foot which average out to about $50. Since gross square feet (which is total area enclosed within the outside walls including walls, stairwells, halls, etc.) run about 50 percent higher than assignable square feet, we can conclude that the cost was about $75 per ASF. His figures were for buildings only and the construction dates varied from 1964 to 1967. Given the rapid increase in construction costs in the last few years, Smythe's figures correspond quite closely to Browne's.

The U.S. Public Health Service certainly has information on construction costs for health research facilities, but they seem to release only the grossest of summaries for publication. For example, the Surgeon General's annual report on health research facilities has estimates of costs per square foot for the previous year. For example, in 1966 the costs were estimated at $61.34 per assignable square foot.[45] Unfortunately, the emphasis of the report is on PHS awards and not total cost of new facilities. Thus the table of individual awards cannot be used to accurately estimate the cost per square foot by state or type of facility. Perhaps they will consider such an analysis for a special report in the future.

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[44] Smythe, C. McC., "Developing Medical Schools: An Interim Report," Journal of Medical Education, Vol. 42, No. 11, November 1967, pp. 991-1004.

[45] "Eleventh Annual Report on Health Research Facilities by the Surgeon General of the Public Health Service," House Document No. 134, 90th Congress, 1st Session, 1967, Washington: GPO.

In the analysis of this paper, we use an estimate of floorspace cost as of July 1968. We have deflated the July 1970 figure of $200 per ASF down to $167 per ASF based on the change in the Engineering ~~News~~ Record (ENR) construction cost index. In July 1970 the ENR index stood at about 1,350 and for July 1968 it stood at about 1,150.

Useful Life of Medical School Facilities

Despite the fact that medical school administrators are continually faced with the problem of obsolete and obsolescent facilities, we have never seen a discussion of the expected useful life of new or existing facilities. And to make rational capital investment decisions without considering life expectancy of the facilities is virtually impossible.[46] This preliminary investigation of the subject provides a rough estimate of the useful life of medical school facilities and indicates two approaches to the study of the problem.

If one is willing to assume that health-related research facilities at medical schools have the same life expectancy as all medical school facilities then one can utilize the results of a recent NIH

[46] It is disturbing that requests for funds for capital projects typically fail to provide estimates of expected useful life.

survey in this analysis. Medical school respondents to the Survey of Health-Related Research Facilities run by NIH in 1968 indicated that about 10.7 percent of health-related research space ought to be remodelled each year "in order to maintain its effectiveness." In contrast they indicated that about 4.3 percent of health-related research space actually was remodelled.[47] Given the tremendous costs of remodelling these days, there is certainly a great deal of pressure to use existing facilities, even unremodelled facilities, for as long as possible. And as long as a school is willing to put up with outmoded facilities (whether for lack of funds or because facilities still have some utility), we would be inclined to say that the facilities have not reached the end of their useful life. Thus the 4.3 percent figure is probably a good guideline figure.

Now let us consider how to translate this figure into an expected useful life. If construction were stable (i.e., 4.3 percent of facilities were remodelled every year and there were no growth), then one could divide 100 percent by 4.3 percent to obtain the average lifespan of 23 years. In a period of expansion, this procedure tends to overestimate the lifespan since the average age of facilities is less than if the same amount of floorspace had

[47] Health Related Research Facilities in the U.S. in Nonprofit Nonfederal Sector, 1968, Report of a survey conducted for Department of HEW, NIH, Health Research Facilities Branch (Bethesda, Maryland: Westat Research, April 15, 1969), p. 29. [Reprinted by U.S. Department HEW, NIH.]

been constructed in a stable period. Thus we conclude from this analysis that the useful life of health-related research facilities at medical schools is about 20 years.

A second approach to the problem involves looking at actual medical school buildings to determine their age and use. Table E-1 and E-2 list the buildings at UCSF campus and indicate their age, use, etc.[48] We offer the following generalization based on these tables:

1. Major buildings seem to last about 60 years before they are razed or are completely remodelled and renovated.
2. Support buildings are smaller and seem to last about 30 years.
3. The majority of buildings (other than hospitals) more than 30 years old seem to have changed use.
4. Most of the buildings on campus are less than 20 years old.

Since most of the buildings on campus are less than 20 years old, it is hard to make statements about useful life. Ideally one would like to have a list of all buildings, existing or razed, at all medical schools in the U.S. This would allow us to make more reliable generalizations.

[48] Readers should note that UCSF probably is an atypical facility; it is built on the side of a mountain. This may limit the usefulness of this empirical data but the methodology should still be useful.

TABLE E-1

BUILDINGS RAZED OR NOT USED FOR ORIGINAL PURPOSE AT UCSF AS OF 1969

Building	Outside Square Feet	Current Use	Original Use	Year Built	Year Razed	Age When Razed	Current Age
Dentistry-Pharmacy	62,858	Dent.-Pharm.	Medicine	1896	1956	60	--
Heating Plant	5,080	Heat	Heat	1931	1968	37	--
Hooper Foundation	17,140	Hooper	Vet. Med.	1896	1966	70	--
Maintenance Shops	13,092	Maintenance	Storage	1963	--	--	6
MR Annex 1	1,008	Hooper	Isolation Studies	1940	--	--	29
MR Annex 3	1,360	Small Animals	Incineration	1931	--	--	38
MR Annex 4	12,254	Computer + Labs	Student Nurse Dorm	1944	--	--	25
Medical School Building	71,270	Offices + Labs	Medical School	1896	1966	70	--
Shop Building	6,876	Shop	Shop	1933	1963	30	--
Surge Unit 1	10,800	New Faculty	Lab + Office	1965	--	--	4

Source: The Centennial Record of the University of California, Berkeley: University of California Printing Department, 1967.

TABLE E-2

BUILDINGS (OTHER THAN HOUSING AND MILLBERRY) USED

FOR ORIGINAL PURPOSE AT UCSF AS OF 1969

Building	Outside Square Feet	Year Built	Current Age
Clinics	103,160	1933	36
Addition	5,727	1964	5
Generator Plant	2,294	1947	22
HSIR	423,953	1966	3
Incinerator	4,500	1953	16
Laundry-Storehouse	35,567	1952	17
MR 1	16,292	1940	29
Medical Sciences			
1	202,560	1954	15
2	176,600	1958	11
Moffitt Hospital	273,595	1955	14
Greenhouse	996	1964	5
Langley Porter	105,000	1943	26
Proctor	4,900	1956	13
Addition	4,921	1965	4
Radiology	10,548	1951	18
UC Hospital	141,070	1917	52
Addition		1957	12
Addition		1962	7

Source: The Centennial Record of the University of California, Berkeley: University of California Printing Department, 1967.

APPENDIX F

BEDS PER WEIGHTED STUDENT FOR MAJOR AFFILIATE HOSPITALS OF U.S. MEDICAL SCHOOLS

	Medical School	Number of Major Affiliate Hospitals[a]	Total Beds[b]	Weighted Students[c]	Beds per Student
10	Alabama	4	1,357	435	3.12
11	Arkansas	2	2,428	347	7.00
12	Loma Linda	2	807	293	2.75
13	U.C. Los Angeles	3	2,262	883	2.56
14	Univ. of Southern Calif.	2	2,407	796	3.02
15	Stanford	3	2,826	431	6.55
16	U.C. San Francisco	5	2,286	766	2.98
17	Colorado	3	1,150	583	1.97
18	Yale	3	1,794	484	3.70
19	Georgetown	6[d]	1,414	500	2.82
20	George Washington	8[d]	2,513	573	4.38
21	Howard	2[d]	800	359	2.22
22	Florida	2	765	328	2.33
23	Miami	2	1,878	576	3.26
24	Georgia	3	2,466	488	5.05
25	Emory	4	1,740	554	3.14
26	Chicago Medical	4[d]	2,118	440	4.81
27	Northwestern	6[d]	2,784	746	3.73
28	Loyola, Stritch	3[d]	1,876	389	4.82
29	University of Chicago	2[d]	1,148	427	2.68
30	Illinois	5[d]	2,573	906	2.83
31	Indiana	3	1,870	704	2.65
32	Iowa	2	1,600	517	3.09
33	Kansas	3	1,141	477	2.39
34	Kentucky	2	2,035	328	6.20
35	Louisville	2	524	391	1.34
36	LSU, New Orleans	2[d]	1,110	494	2.24
37	Tulane	1[d]	1,110	500	2.22

	Medical School	Number of Major Affiliate Hospitals[a]	Total Beds[b]	Weighted Students[c]	Beds per Student
38	Johns Hopkins	2[d]	1,652	552	2.99
39	Maryland	3[d]	1,527	571	2.67
40	Boston University	3[d]	1,087	397	2.73
41	Harvard	9[d]	3,346	1,069	3.13
42	Tufts	7[d]	2,213	317	6.98
43	University of Michigan	4	2,549	910	2.80
44	Wayne State	8	4,161	857	4.85
45	Minnesota	4	2,838	934	3.03
46	Mississippi	2	842	324	2.59
47	Missouri	1	461	339	1.35
48	St. Louis	5[d]	1,318	435	3.02
49	Washington University	7[d]	3,214	709	4.53
50	Creighton	5[d]	991	230	4.30
51	Nebraska	6[d]	869	313	2.77
52	Dartmouth	2	507	146	3.47
53	New Jersey	3	2,159	492	4.38
54	Albany Medical Center	2	1,781	362	4.91
55	SUNY Buffalo	3	1,777	505	3.51
56	Albert Einstein	3	2,260	641	3.52
57	Columbia	6	3,349	871	3.84
58	Cornell	1	1,153	390	2.95
59	New York Medical College	3	3,033	641	4.73
60	New York University	2	2,558	678	3.77
61	SUNY, Downstate	7	6,156	1,659	3.71
62	Rochester	3	1,277	470	2.71
63	SUNY, Upstate	4	1,607	309	3.41
64	North Carolina	1	416	350	1.18
65	Duke	2	1,222	458	2.66
66	Bowman-Gray	1	524	253	2.07
67	Cincinnati	3	1,370	545	2.51
68	Case Western Reserve	3	2,316	654	3.54
69	Ohio State	5	2,559	660	3.87
70	Oklahoma	3	1,092	391	2.79
	Oregon	2	1,198	412	2.90

	Medical School	Number of Major Affiliate Hospitals[a]	Total Beds[b]	Weighted Students[c]	Beds per Student
72	Hahnemann	3[d]	1,677	464	3.61
73	Jefferson	5[d]	3,368	680	4.95
74	Temple	5	2,555	668	3.82
75	Pennsylvania	7[d]	2,778	908	3.05
76	Womens	3	632	235	2.68
77	Pittsburgh	7	3,142	461	6.81
78	South Carolina	3	989	358	2.76
79	South Dakota	-	--	--	--
80	Tennessee	5	3,568	712	5.01
81	Meharry	1	224	196	1.14
82	Vanderbilt	3	1,258	324	3.88
83	Texas, SW (Dallas)	3	1,719	544	3.15
84	Texas (Galveston)	1	984	525	1.87
85	Baylor	7	3,453	673	5.13
86	Utah	2	805	293	2.74
87	Vermont	1	623	233	2.67
88	Virginia	1	564	353	1.59
89	M.C. of Virginia	4	2,788	619	4.50
90	University of Washington	5	1,530	537	2.84
91	Western Virginia	1	430	242	1.77
92	Wisconsin	4	2,020	687	2.94
93	Marquette	4	1,861	539	3.45
94	U.C. Irvine	4	3,010	404	7.45
95	New Mexico	2	754	180	4.18
96	North Dakota	-	--	--	--
97	Michigan State	2	801	--	--
98	Rutgers	-	--	--	--
99	Arizona	2	482	--	--
100	Brown	5[d]	1,611	--	--
101	U.C. Davis	1	620	--	--
102	U.C. San Diego	-	--	--	--
103	Connecticut	1	213	--	--
104	Hawaii	5	1,087	--	--
105	LSU, Shreveport	1	830	--	--

		Number of Major Affiliate Hospitals[a]	Total Beds[b]	Weighted Students[c]	Beds per Student
106	Massachusetts	-	--	--	--
107	Mount Sinai	1	1,176	--	--
108	SUNY, Stonybrook	-	--	--	--
109	Pennsylvania State	-	--	--	--
110	Texas (San Antonio)	-	--	--	--
111	M.C. of Ohio	-	--	--	--
112	Mayo	-	--	--	--
	Total[e]		154,896	44,400	3.49

[a]Excludes large psychiatric hospitals. Includes hospitals owned by medical schools; nearly fifty schools own a hospital.

[b]Beds for hospitals that are affiliated with more than one medical school are allocated equally among the schools.

[c]Sum of residents, interns and half the undergraduates. Interns and residents in programs at hospitals with multiple affiliations are allocated equally among the schools. Except, of course, where the allocation is noted specifically.

[d]One or more of the hospitals is also affiliated with another school.

[e]Sum over schools with complete data.

NOTE: Of the six schools with large bed-student ratios, five have affiliations with large VA hospitals:

Arkansas: VA (Little Rock) 2,126 beds.
Stanford: VA (Palo Alto) 2,046 beds.
Kentucky: VA (Lexington) 1,120 beds.
Pittsburgh: VA (Pittsburgh) 1,131 beds.
U.C. Irvine: VA (Long Beach) 1,675 beds.

Source: Director of Approved Internships and Residencies, 1969-70, Chicago, AMA, 1969.

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